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Subject: Deliverable Number 0006, Rail Network Capacity Analysis Report

Reference: Strategic Mobility 21 Contract N00014-06-C-0060

Dear Paul,

In accordance with the requirements of referenced contract, we are pleased to submit this Rail Network Capacity Analysis Report for your review.

Your comments on this document are welcomed.

Regards,

Dr. Lawrence G. Mallon
Strategic Mobility 21 Program Manager

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Strategic Mobility 21

Rail Network Capacity Analysis

Contractor Report 0006

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In fulfillment of the requirements for:

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Strategic Mobility 21 – CLIN 0006

Prepared and Submitted by:

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September 30, 2006

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14. ABSTRACT

This analysis examined the rail network capacity and average transit times for commercial and surge military deployments through the proposed Victorville - Joint Power Projection Support Platform (JPPSP) and trans-loading to vessels at Southern California (SOCAL) ports, as part of the Strategic Mobility 21 (SM21) program. Dependable rail service is needed to eliminate port congestion. Baseline rail dispatch simulations were analyzed to determine current baseline and forecasted shipment impact on regional rail main line segments capacity and the further impact of military deployments. The military deployment scenarios studied were: (1) Containerized Surge Sustainment and a Stryker Brigade deployed through the Port of Long Beach, and (2) a notional military force deployed through the Port of San Diego. The analysis concluded that if the 2010 and 2025 Scenario improvements analyzed in this report were implemented, the speed and reliability of both military surge deployments and commercial traffic would be significantly improved, in spite of continued strong growth in commercial traffic.

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ABSTRACT

The purpose of this analysis is to examine the rail network capacity and average transit times for both commercial and surge military deployments through the proposed Victorville - Joint Power Projection Support Platform (JPPSP) and trans-loading to vessels at Southern California (SOCAL) ports. Dependable rail service is required to eliminate port congestion, which would provide additional port capacity for commercial operations and minimize the impact of military deployments. The result of this analysis will be used as an input to the next tier models which support the design of a multi-modal terminal at Victorville.

This analysis included baseline rail dispatch simulations to determine current baseline and forecasted shipment impact on regional rail main line segments capacity and the further impact of military deployments. The military deployment scenarios studied were:

1. Containerized Surge Sustainment and a Stryker Brigade deployed through the Port of Long Beach, and
2. A Notional military force deployed through the Port of San Diego.

The Leachman & Associates LLC rail dispatch simulation model was used for the analysis. Statistics were tabulated from simulation runs concerning the mean and standard deviation of transit times from one hundred simulated days of train operations for 2000-2025 commercial rail traffic levels and trackage configurations. Subsequent simulations overlaid the military deployments on top of forecasted commercial traffic levels and forecasted trackage configurations in years 2010 and 2025. The analysis indicated that surge deployments at 2006 traffic levels using existing trackage would result in a four-hour difference between mean and 98th percentile of origin-to-destination transit times for military deployments operating under ordinary dispatch priority. Reducing this variability would require assignment of unusual priority to the military trains, thereby resulting in unusual commercial delays. The analysis concluded that if the 2010 and 2025 Scenario improvements analyzed in this report were implemented on time, the speed and reliability of both military surge deployments and commercial traffic would be significantly improved compared to current capabilities, in spite of continued strong growth in commercial traffic. Public and private partners are needed to support the 3.2 billion dollar track capacity improvements. This investment will ensure that the Year 2000 transit times and system reliability can be supported in the Year 2025 even with the forecasted increase in the flow of containers and potential military surge deployments simulated during the study.

1.0 INTRODUCTION

This document contains the analysis of rail capacity and average transit times for commercial and surge military deployments through the Victorville Joint Power Projection Support Platform (JPPSP) – Barstow, CA area and trans-loading to vessels at Southern California (SOCAL) ports. The Victorville JPPSP is being developed as a dual use facility (meaning military and commercial) to support the SOCAL Strategic Ports. This analysis supports the JPPSP requirement to minimize the amount of commercial containerized cargo and military unit equipment pre-positioned for loading at the SOCAL ports. The JPPSP facility and distribution process for commercial and military shipments is depicted in Figure 1 below. Dependable rail service is required to support the just-in-time movement of shipments into SOCAL ports for loading. The results of this analysis will be used as input to two additional models that will be used to design the JPPSP multi-modal terminal and the supporting cargo movement processes.

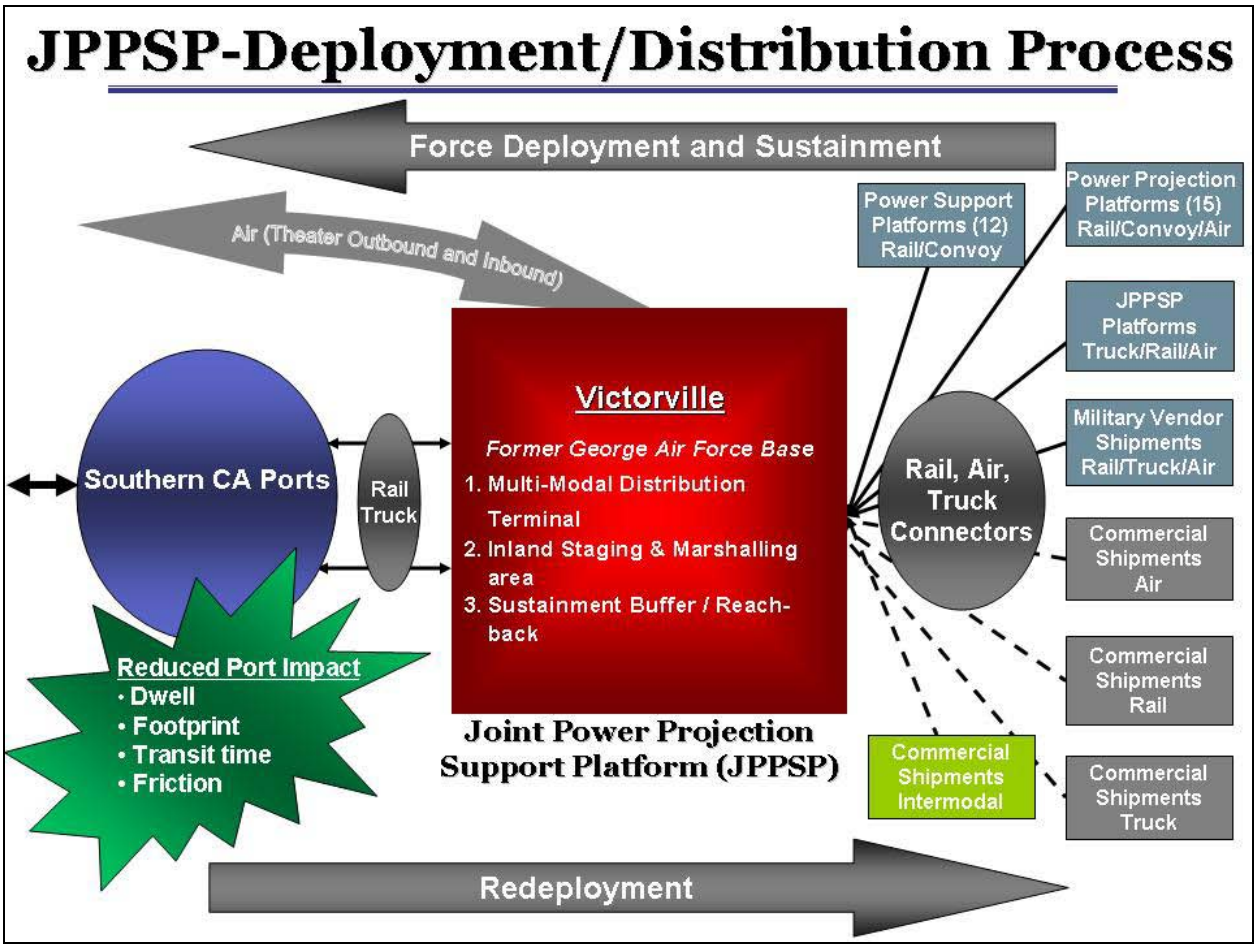

Figure 1. Joint Power Projection Support Platform Design and Process Overview

The analysis documented in this report includes baseline rail dispatch simulations to determine current baseline and forecasted impact on regional rail main line segments capacity. Two deployment scenarios are studied separately: (1) Containerized Surge Sustainment and a Stryker

Brigade deployed through the Port of Long Beach, and (2) a Notional military force deployed through the Port of San Diego. The expected transit times for these movements and for commercial rail movements with which the surge deployments must share tracks are studied for both current and future track capacity and for current and future levels of commercial rail traffic.

2.0 STUDY APPROACH

The Leachman & Associates LLC rail dispatch simulation model was used to exercise with input data representing:

- The commercial traffic of freight trains and passenger trains, and
- The military surge sustainment and notional military force deployment overlaid on input data of commercial traffic on the main line rail network.

Statistics were tabulated from simulation runs concerning the mean and standard deviation of transit times from one hundred simulated days of train operations. Initial simulations overlaid the surge deployments on top of 2006 commercial rail traffic levels and trackage configurations. Subsequent simulations overlaid the surge deployments on top of forecasted commercial traffic levels and forecasted trackage configurations in years 2010 and 2025.

2.1 The Main Line Rail Network

Southern California is served by two major freight railroads: Burlington Northern Santa Fe (BNSF), and Union Pacific Railroad (UPRR). Figures 2 and 3 provide diagrams of the main line rail network in the study area (not to scale). Not shown in the figures are numerous low-density branch lines for originating and terminating carload freight.

BNSF operates a single main line extending from downtown Los Angeles to Barstow. Intermodal terminals are operated by BNSF at Hobart (adjoining the City of Commerce) and San Bernardino. UPRR trains utilize trackage rights over the BNSF line from West Riverside to Barstow. The entire BNSF line has at least two main tracks, reverse-signaled under centralized traffic control (CTC), with three main tracks over relatively short stretches in various locales. Expansion of three-main-track territory is underway. Most recently, a third main track was completed in late 2004 over 6.5 miles of line between Baseline Road in San Bernardino and Verdemont, and expansion of three-main-track territory is currently underway to encompass the entire run between Hobart and Fullerton.

In Year 2000, 87 freight trains and two Amtrak passenger trains per peak day[1] traversed the portion of the BNSF Line crossing Cajon Pass. These figures are forecast to rise to 123 freight trains and 6 passenger trains in 2010, and 178 freight trains and 8 passenger trains in 2025. Passenger train movements over the BNSF Line are heaviest between Fullerton and Los Angeles. In Year 2000, this segment had 46 passenger trains and 57 freight trains per peak day. Those figures are forecast to rise to 76 passenger trains and 82 freight trains in 2010 and 106 passenger trains and 121 freight trains in 2025.

[1] A peak day is defined as a day experiencing the 90th percentile of the distribution of daily through train movements.

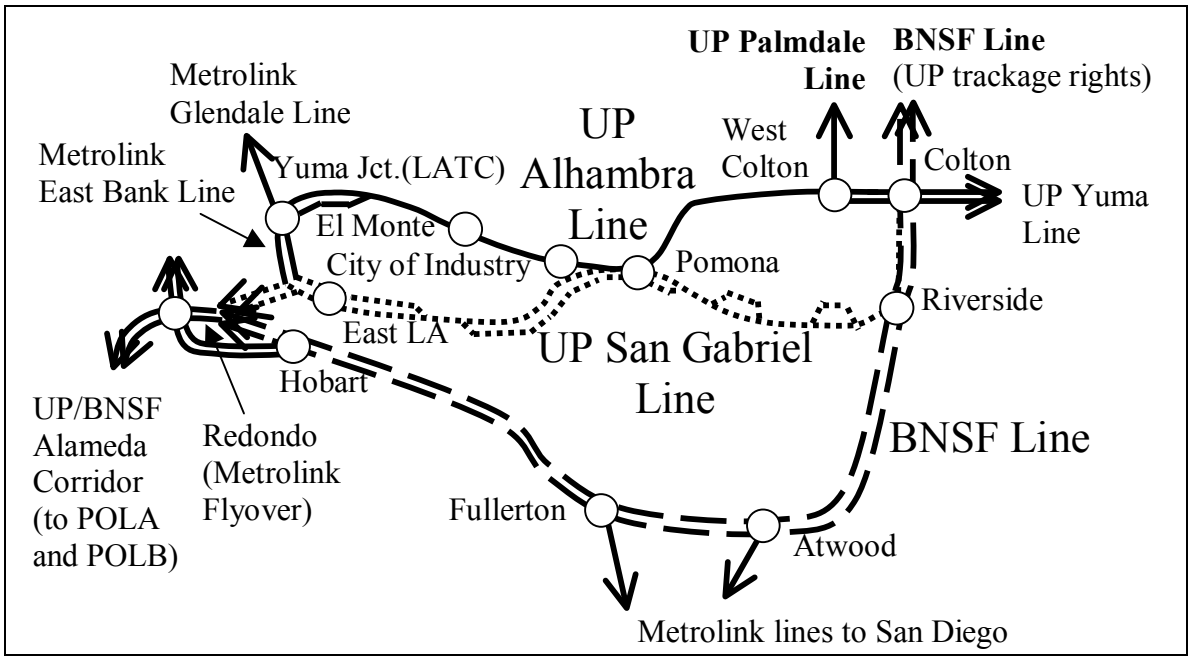

Figure 2. Main Line Rail Network, West of Colton Crossing

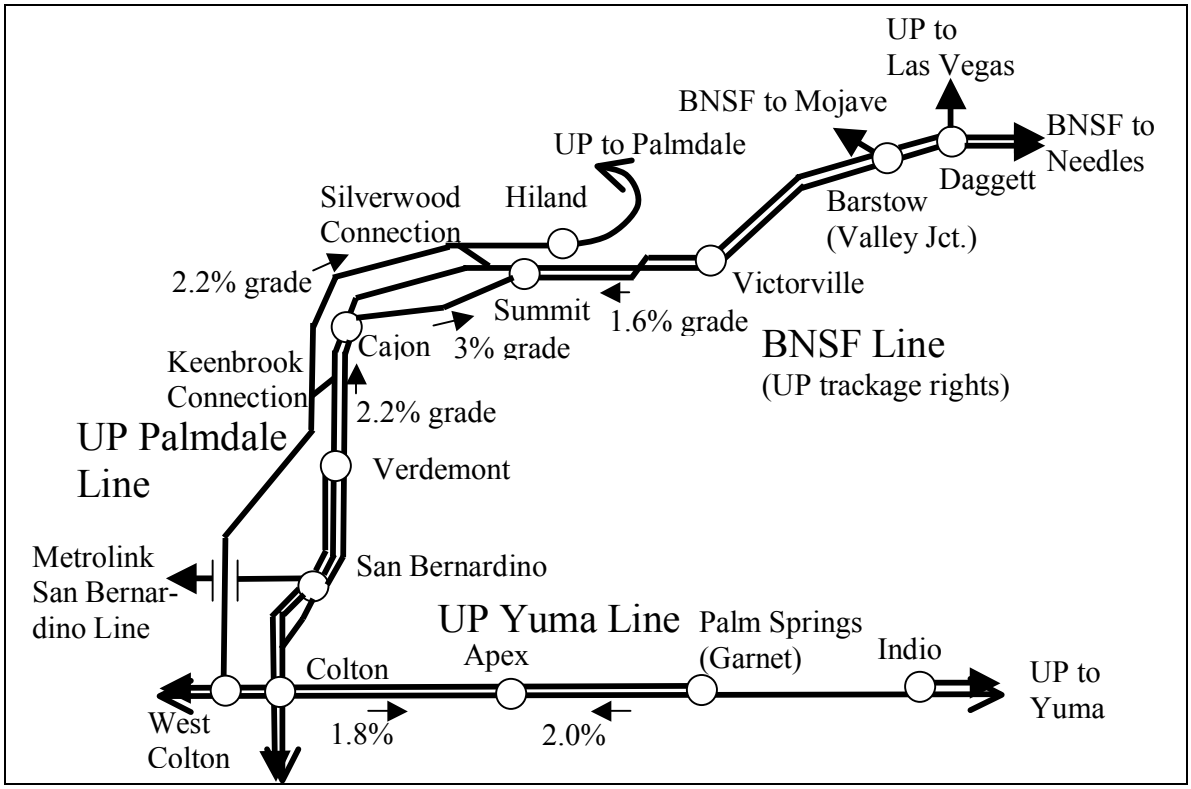

Figure 3. Main Line Rail Network, North and East of Colton Crossing

UPRR operates two main lines between downtown Los Angeles and Colton Crossing. In this report, these lines are designated as the UPRR San Gabriel Line and the UPRR Alhambra Line. These lines consist of a mixture of single-track and two-main-track territories operated under CTC. The UPRR Alhambra Line is mostly single-track, while the UPRR San Gabriel Line is mostly two-main-track. Intermodal terminals are operated by UPRR at East Los Angeles (at the west end of the UPRR San Gabriel Line), Los Angeles Transportation Center (at the west end of the UPRR Alhambra Line) and City of Industry (midway on the UPRR Alhambra Line). A large carload freight classification yard is located at West Colton (at the east end of the Alhambra Line). North from West Colton, UPRR operates the single-track-CTC Palmdale Line to Northern California and Pacific Northwest points. This line closely parallels the BNSF Line as they climb the south slope of Cajon Pass. Compared to other main lines in the study area, the UPRR Palmdale Line is lightly trafficked.

In Year 2000, UPRR operated 59 through freight trains per peak day collectively over the UPRR San Gabriel and UPRR Alhambra Lines. This figure is forecast to rise to 83 trains in 2010 and 117 trains in 2025. On the Yuma Line, UPRR operated 42 freight trains per peak day in Year 2000. That figure is forecast to grow to 60 trains in 2010 and 87 trains in 2025.

Passenger train movements over UPRR tracks in the study area are heaviest on the UPRR San Gabriel Line. Including both Metrolink and Amtrak, in Year 2000, there were 12 trains per peak day over this line, forecast to rise to 22 trains in 2010 and 36 trains in 2025. In contrast, passenger movements over the UPRR Alhambra and Yuma Lines are very light, only 2 trains per peak day in Year 2000, forecast to rise to 4 trains in 2010 and 8 trains in 2025. There are no regular passenger movements over the UPRR Palmdale Line.

Figure 2 also shows the junctions between BNSF or UPRR main lines and main lines owned by others that provide access to the Southern California ports. Diverging from the BNSF line at Atwood, Metrolink-owned trackage serves as the route for BNSF freight trains to and from San Diego. From connections at Redondo Jct. with the BNSF and UPRR main lines, the Alameda Corridor serves as the route for both BNSF and UPRR freight trains to and from the Ports of Los Angeles and Long Beach.

2.2 Simulated Military Surge Deployments

The Surge Sustainment and Stryker Brigade deployments involve a combination of trains consisting of double-stacked container cars and chain tie-down cars through Victorville to the Port of Long Beach and return. Two 6,000-foot trains per day in each direction are assumed observing ordinary railroad stack-train speed limits and horsepower-per-ton policies. Inter-departure times are randomized with mean equal to twelve hours.

The notional military force deployment through the Port of San Diego involves four trains of chain tie-down cars loaded with tanks and other military vehicles from Barstow to Atwood (en route San Diego) and four returning trains. Four 5,000-foot trains per day in each direction are assumed. Considering intercity and commute passenger train operations on the San Diego Line, these train movements need to be fleeted. Departure times from Barstow at 1800, 1830, 1900 and 1930 are assumed. Departure times from Atwood (northbound) at 0330, 0400, 0430 and

0500 are assumed. These trains are assumed to observe ordinary railroad carload freight train speed limits and horsepower-per-ton policies.

A detailed break-down of commercial freight and passenger train movements per peak day on the rail main lines in the study area for Year 2000 (actual), Year 2010 (forecast), and Year 2025 (forecast) is documented in a 2005 SCAG-sponsored study by the author.[2] These movements are assumed in this study, whereby the surge military deployments are overlaid on this traffic base.

2.3 The Simulation Model

Since 1983, Leachman and Associates has progressively developed simulation methodology to model the complicated rail networks in the Los Angeles-Inland Empire trade corridor region. The simulation model is based on a discrete event methodology and developed using the Awesim© Simulation Language.[3] Physical resources modeled include rail junctions for crossover movement in a rail network, and physical track divided into track segments with uniform speed limits. The simulation network comprises of nodes and arcs, where nodes consist of one or more contiguous segments, and arcs represent movement from one node to another.

Simulation statistics are compiled for 100 consecutive peak-days (which effectively 'stress-tests' the improvements). Freight train departure times are randomized, while passenger train departure times are fixed. The model incorporates assumptions about train lengths and tonnages, acceleration and deceleration rates, track configurations, and speed limits. The model also incorporates traffic control logic to resolve conflicts and thereby 'dispatch' the railroad. Technical discussions of the traffic control logic and simulation methodology are summarized below. Further details are available in the open academic literature.[4]

Figure 4 provides a simplified overview of the rail dispatch model. Data inputs to the model include Train Schedule, Train Type, and Track Network. Train Schedule with origin station generates Departing Train Entities and is stored in the Event Calendar. Event Calendar interacts with the Central Dispatching Algorithm to decide on moving the train entity or on stopping the train. Moving the train will seize resources and generate next events, while stopping the train will cause the train to decelerate, stop, and be placed in a queue to wait. Finally, in case the arrival train terminates, information is recorded. The primary simulation outputs are the average delay and flow times of the trains.

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[2] *Inland Empire Main Line Rail Study Final Report*, prepared for Southern California Association of Governments, Contract 04-010, June 30, 2005. The report may be downloaded from the SCAG web site, http://www.scag.ca.gov/goodsmove/pdf/FinalElasticityReport0905rev1105.pdf .

[3] Pritsker, A. B. and J. J. O'Reilly. 1999. *Simulation with Visual SLAM and Awesim.* John Wiley & Sons, Inc., New York.

[4] Lu, Quan, Maged Dessouky, and Robert C. Leachman, "Modeling Train Movements Through Complex Rail Networks," *ACM Transactions on Modeling and Computer Simulation,* Vol. 14, No. 1, January, 2004, p. 48-75. See also Dessouky, Maged, Robert C. Leachman and Quan Lu, "Using Simulation Modeling to Assess Rail Track Infrastructure in Densely Trafficked Metropolitan Areas," *Proceedings of the2002 Winter Simulation Conference*, E. Yücesan, C.-H. Chen, J. L. Snowdon, and J. M. Charnes, eds., 2002.

Input data to the model includes the rail network (line segments, junction and crossover switches, speed limits), train types (priority, origin, destination, length, maximum speed, acceleration and deceleration rates), and train schedules (origin and destination, train type, starting times). For the purposes of the current study, maximum speed and acceleration rates were made a function of line gradient in order to accurately simulate operation of heavy trains over mountain grades. Values for maximum speed and acceleration rate as a function of gradient were pre-computed based on train tonnage; locomotive horsepower, weight and tractive effort; and standard assumptions for rolling resistance and locomotive efficiency and adhesion. A network schematic of the Year 2000 rail network between Barstow and downtown Los Angeles is provided as an appendix to the 2005 SCAG study.[5]

The simulation logic is briefly summarized as follows. An event calendar is maintained within the simulation containing events for trains ready to depart and train arrivals at junctions and end points of track segments. A central dispatching algorithm is called to process each event and decide whether the train should continue moving (i.e., take possession of additional track resources) or begin to decelerate to a stop. A train is simulated to begin decelerating to a stop either when the necessary track segment or junction resource has been awarded to some other movement, or a continuation of its movement would cause a deadlock. If the train is stopped, the train is placed in a queue to wait for an available track resource.

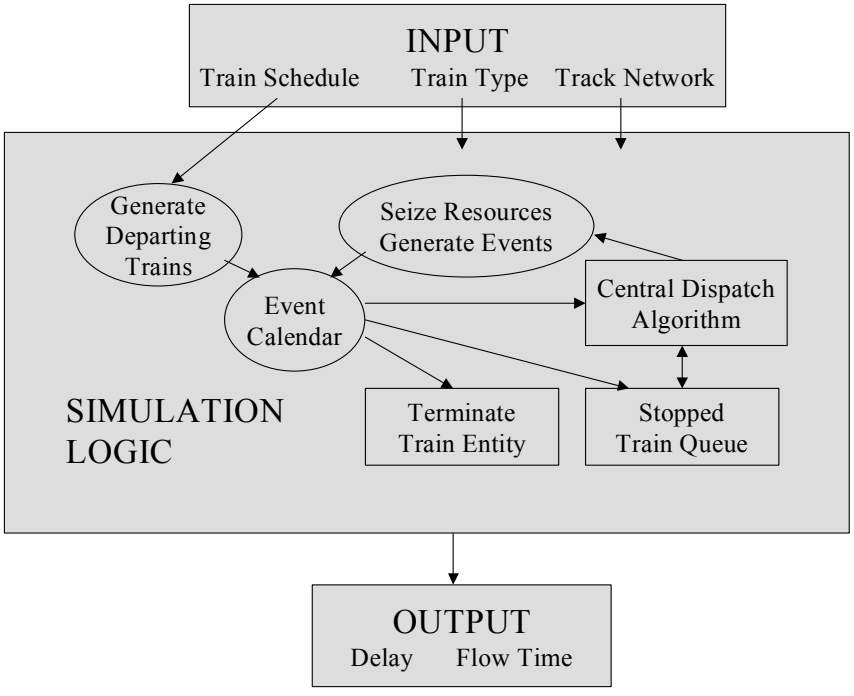

Figure 4. Overview of Rail Dispatch Model Structure

[5] *Inland Empire Main Line Rail Study Final Report*, prepared for Southern California Association of Governments, Contract 04-010, June 30, 2005. The report may be downloaded from the SCAG web site, http://www.scag.ca.gov/goodsmove/pdf/FinalElasticityReport0905rev1105.pdf .

If the central dispatching algorithm decides to move the train, the algorithm determines the following:

- The distance the train travels within the awarded resource.
- The time of travel over the resource, accounting for change-of-speed points.
- The successor track resources that could be possessed by the train.

The algorithm assigns the track resources to the train and schedules 'resource-free' events that release track resources the train no longer needs during this movement. Ultimately, an event is scheduled to represent the time the train finishes movement.

When a resource-free event is processed, all the trains in the stopped train queue are checked to see whether this released resource can trigger a movement for one of the stopped trains. The triggered train in the queue is the one with the highest priority and longest waiting time. Its movement will be determined by the central dispatching algorithm in the same manner as described above.

Finally, if the event is a train arrival at its destination terminal, statistics concerning the train movement will be recorded and the train will be terminated from the system. When the simulation finishes, the primary outputs are the average delay and transit time by train type and origin-destination pair.

2.3.1 Input and Output Files

Input data for the train dispatching simulation model is categorized in terms of the Track Network, Train Types, and Train Schedules.

The Track Network data (i.e., the physical rail network) is represented in terms of two types of resources: (1) track segments and (2) junction switches. Each segment of track has a specified uniform speed limit and extends between other segments with different speed limits or junctions in the network for crossover or diverging movement. Parallel tracks are distinct segments. Maximum speed over junction switches also is specified in this data.

The Train Type data specifies the train length, maximum speed, and acceleration and deceleration rates for each train type. The latter three parameters are a function of the line gradient.

The Train Schedule data specifies the train type, origin and destination for each train ID. It also specifies inter-arrival times (i.e., times between consecutive departure times for the same train ID). Inter-arrival times may be fixed as a schedule or they may be randomized by the simulation according to user-specified probability distributions.

Year 2000, Year 2010 and Year 2025 Train Schedule data for all main line rail movements west and south of Colton Crossing were developed by Leachman and Associates in a 2002 study for

SCAG.[6] These include all movements over main line tracks from the south end of the Alameda Corridor to Colton Crossing via Union Pacific and Burlington Northern Santa Fe main lines. Metrolink lines utilized by UPRR and BNSF main line trains also are included. Year 2000, Year 2010 and Year 2025 Train Schedule data for all main line rail movements were developed by Leachman and Associates in a 2005 study for SCAG. These include all movements over the UPRR Yuma Line (Colton – Indio), the BNSF Cajon Line (Colton – Barstow), and the UPRR Palmdale Line (West Colton – Hiland).[7]

Output data from the simulation consists of text files of statistical summaries by train ID and by location. The summary by train ID specifies the following information for each train ID:

- Transit time: mean, standard deviation, minimum, maximum
- Delay: mean, standard deviation, minimum, maximum
- Mileage: mean, standard deviation, minimum, maximum (Note: mileage may vary when there are alternative routes through the rail network for a given train ID)
- Size of queue of waiting trains at origin station: average, maximum
- Wait time at origin station: average over trains that waited
- Probability train waits at origin station (i.e., fraction of simulated trains that were delayed from starting)

The summary by location ('node') specifies the following information for each location and train ID:

- Probability train is stopped at that location (i.e., fraction of simulated trains that were stopped at that location)
- Average wait time when train was stopped

2.4 Model Validation

The Leachman and Associates' train dispatching model was validated in an earlier study.[8] A brief summary of that validation is provided here.

A data set of 25 actual Burlington Northern Santa Fe double-stack container train movements operating over a thirty-day period (mid-April to mid-May, 2003) was obtained from the railroad. These trains originated at the Maersk/APM on-dock rail terminal in the Port of Los Angeles and were destined to eastern points, primarily Chicago. The data set provided by BNSF included

[6] Los Angeles Economic Development Corporation, *Los Angeles – Inland Empire Railroad Main Line Advanced Planning Study,* prepared for Southern California Association of Governments, Contract number 01-077, Work element number 014302, October 1, 2002.

[7] *Inland Empire Main Line Rail Study Final Report*, prepared for Southern California Association of Governments, Contract 04-010, June 30, 2005. The report may be downloaded from the SCAG web site, http://www.scag.ca.gov/goodsmove/pdf/FinalElasticityReport0905rev1105.pdf .

[8] Mallon, Larry G., J. D. Hwang and R. C. Leachman, *Optimization of Military and Commercial Goods Movement Through Southern California Using Information Technology*, prepared for US Navy Space and Naval Warfare Systems Center, Center for Commercial Deployment of Transportation Technologies, Cal-State University at Long Beach, Sept., 2003.

passing times at selected points for the actual Maersk container train movements. The southernmost passing point is CP Sepulveda (1.3 miles north of Long Beach Jct., the junction between lines to Terminal Island and the Port of Long Beach proper); the northernmost passing point is Colton Crossing.

Operation of these same 25 trains was simulated between Long Beach Jct. and Colton Crossing, juxtaposed with all the Year 2000 traffic levels described in earlier sections of this report. Simulation results for the 25 Maersk stack trains between CP Sepulveda and Colton Crossing were compared to statistics on the actual transit times between these points in order to validate the simulation model.

Undertaking a train-by-train review of the passing times of the actual train movements, two anomalies were discovered. Train #19 experienced a three-hour delay between Hobart and Pico Rivera, and train #22 experienced a 2 hour, 45 minute delay between Riverside and Colton. Evidently there were disruptions (e.g., trackside detector alarms, pickups or setouts, change of locomotives, etc.) impacting these two train movements. Such disruptions are not included in our simulations. Thus, we did the comparison without these two trains.

Considering the 23 BNSF trains (trains #19 and 22 removed), statistics on actual and simulated transit times CP Sepulveda - Colton Crossing are displayed in Table 1. As may be seen, the statistics on actual and simulated trains are remarkably close. The very minor differences are well within the levels of expected variability for 23 train movements.

Table 1. Actual vs. Simulated Transit Times, CP Sepulveda – Colton Crossing

Statistic	Actual	Simulated
Mean	3 hours, 26 minutes	3 hours, 28 minutes
Standard deviation	0 hour, 43 minutes	0 hours, 51 minutes
Minimum	2 hours, 10 minutes	2 hours, 27 minutes
Maximum	4 hours, 53 minutes	5 hours, 01 minutes

Source: Mallon, Larry G., J. D. Hwang and R. C. Leachman, *Optimization of Military and Commercial Goods Movement Through Southern California Using Information Technology*, prepared for US Navy Space and Naval Warfare Systems Center, Center for Commercial Deployment of Transportation Technologies, Cal-State University at Long Beach, Sept., 2003.

2.5 Qualitative Discussion of Rail Line Capacity

Strictly speaking, there is not a fixed capacity figure appropriate for any given rail line. Average dispatching delays increase whenever more trains are added to a line. Each increment in delay reduces the quality of service and increases the cost of operating the rail line; passenger schedules and freight delivery schedules must be slowed down and more rolling stock is required

per unit of traffic. Figure 5 illustrates the general trade-off between transit time and traffic level. The trade-off is worse, i.e., the transit times rise more sharply, when the line handles a mix of trains that travel at different speeds (e.g., freight and passenger).

Commercial rail traffic levels in the study area are relatively high, tending towards the right side of the idealized curve depicted in Figure 5. Surge military deployments would have a noticeable impact on transit times for commercial traffic. Stability of operations is at present precarious; a derailment generates back-ups that may take days to clear. Major improvements to main-line rail infrastructure in Southern California have been proposed, and some are under construction. As will be discussed, the viability of joint commercial traffic and surge military deployments will be enhanced by these improvements, even considering the growth rates of commercial traffic.

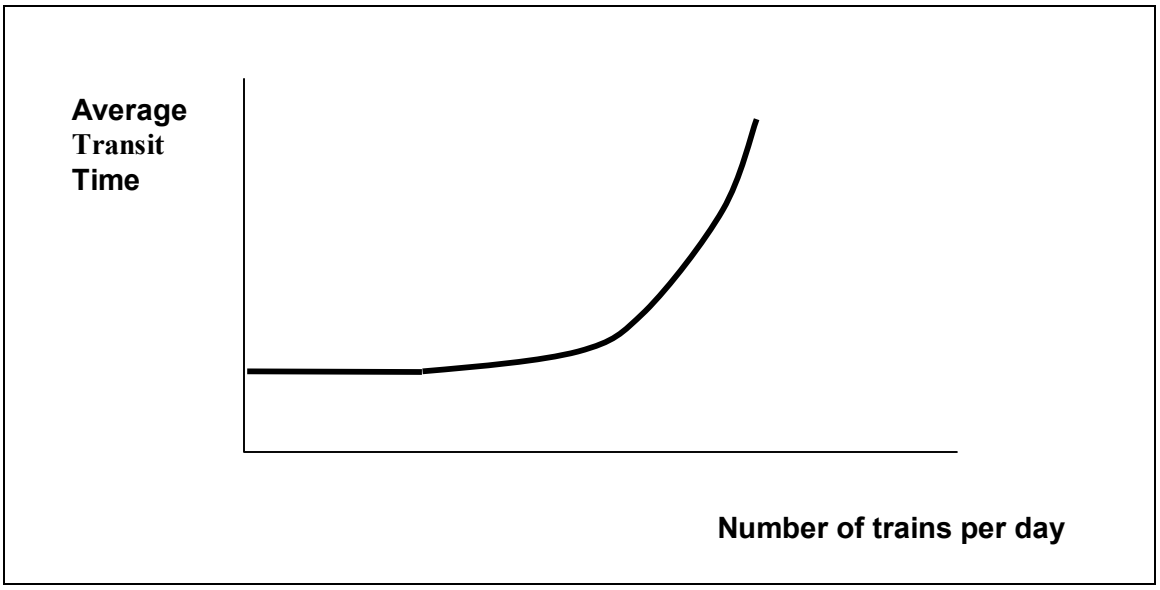

Figure 5. Qualitative Trade-off between Transit Time and Traffic Volume on a Railroad Main Line.

3.0 ANALYSIS OF CRITICAL COMMERCIAL AND MILITARY SCENARIOS

3.1 Railroad Service to Southern California Ports and Barstow Area

Following is a summary of road services and critical interchanges in Southern California freight routes:

- Port of San Diego – Served exclusively by BNSF Railway
- Port of Huennme – Served exclusively by UPRR through a shortline (Ventura County Railroad)
- Port of Long Beach – Served by both BNSF and UPRR
- Port of Los Angeles – Served by both BNSF and UPRR
- Marine Corps Logistics Base (Nebo) – Served by UPRR and BNSF
- Yermo Marine Corps Base – Served exclusively by UPRR
- Interchange of rail traffic between BNSF and UPRR takes place in Barstow

3.2 Choke Point of Cajon Pass for SOCAL Main Line Rail Network

The BNSF Railway Main line through the Cajon Pass is one of the most heavily used freight routes in the U.S. relative to capacity. The route segment includes a minimum of two main tracks. In some areas a third track has been constructed. The current plan is to complete work on the third track addition between San Bernardino and Summit by the end of 2007.

The number of trains operating on the BNSF Cajon Pass track often exceeds 100 each day. The grade ranges from 2.2 % for the uphill track to 3.0% for the downhill track. UPRR has the right to operate on the BNSF's tracks between Daggett and West Riverside. About 25% of the trains operating on this route segment are UPRR's.

UPRR has a Cajon Pass line of its own which runs parallel to the BNSF tracks between San Bernardino and Summit. This line is sometimes referred to as the Palmdale-Colton Cutoff. There are connecting crossover tracks between the UPRR and BNSF lines situated near Summit /Silverwood (north hill) and Devore/Keenbrook (south slope), near the bottom of the heaviest grade. The UPRR line has a single track with sidings. BNSF does not have unrestricted rights to operate on the UPRR track. UPRR recently granted BNSF the right to operate on the track for the sole purpose of delivering interchange rail cars between Barstow and the West Colton Yard of UPRR. This right extends from Summit to West Colton. Although the UPRR line has unused capacity, for competitive reasons it is unlikely that BNSF will be granted full operating trackage rights to operate over the line between Silverwood and Devore.

3.3 Operating Practices of Train Movement in Cajon Pass

The downhill operations through BNSF's Cajon Pass are on a 3% grade. In many instances, train speeds are slow to compensate for the heat generated by the heavy grade from train braking. BNSF's operating practices are such that all westbound trains stop at summit where they are physically inspected for non-authorized riders. Further, westbound trains are not permitted to depart from Summit until the governing movement signal displays a green aspect. A rule of

thumb is that the train intervals are spaced about 30 minutes apart. The spacing time is influenced by downhill train speeds. A faster moving train will clear through signal blocks ahead more rapidly than a slower train. A faster moving train is the light intermodal train such as those operated for UPS. On the surface, it would seem that the spacing trains at 30 minute intervals would limit downhill train throughput to 48 trains each day unless the two tracks are used interchangeably. As noted above, train speed influences time between train spacing.

Although it is possible to interchangeably use both tracks in the Cajon Pass for downhill operations, it is not at all practical to do so for uphill. The trains leaving the Los Angeles Basin are powered to operate on a 2.2% grade – the uphill grade. Moving these trains on the 3.0% grade would require significantly more motive power. It would also severely restrict the amount of trailing tonnage. Trailing tonnage is limited by the tensile strength of the coupling devices between railcars. Relative to 2.2%, a 3.0% grade is much more restrictive regarding trailing tonnage. Because helper engines can be entrained to compensate for trailing tonnage, train size can be adjusted upward. However, the use of helpers is costly, and slows the operation as they are generally entrained at the bottom of the grade and removed at the top of the grade.

A railroad operating practice gaining much use is the one where a consist of four locomotives is divided between the headend and rearend of train, with two locomotives positioned at each end of the train. The locomotive engineer at the head of the train controls the operation of the rear locomotives. The trains depart from terminals with this locomotive configuration and operate through to the destination station. This operation compensates for some of the trailing tonnage issues. However, it does not result in an aggregate reduction of locomotives which are required by a specific grade in some routes.

Another restriction to the interchangeable use of both tracks is that they are not always at the same elevation. Placing crossovers between one track and the other is not possible, so there are limited applications for crossover movements between one track and the other.

There is an imbalance of east and westbound trains on the BNSF Line. This happens because of the train size and the fact that UPRR has several routes into and out of the Los Angeles Basin. What UPRR operates westbound into the Basin may operate eastbound on a different route.

The number of trains operating in the Cajon Pass is less than forecasted in 2000 for the calendar year of 2006. Starting in 2005, BNSF commenced operating longer trains. Whereas the car volume increased at double digit rates, the train volume did not follow the suit. This type of operating leverage cannot be further expanded as the physical plant will not sustain an operation where the trains exceed 8,000 feet in length – the current norm for many trains. A major limitation is imposed by the terminal track lengths at the San Pedro Bay Ports and the railway carriers' own facilities at San Bernardino and Hobart Yard. The absence of additional operating leverage through the train size has created a need to build new line capacity as what BNSF is doing now. It is expected that BNSF will someday construct a yard near Barstow where three 8,000 feet long eastbound trains will be made into two 12,000 foot trains. Distributive locomotive power would then be positioned throughout the train. All locomotives throughout the train would be controlled by the headend locomotive engineer. Because there are frequent road crossings of railroad tracks in the Basin, labor agreement issues, and terminal constraints,

this consolidation will not take place in the Los Angeles Basin. This operating strategy may be postponed for a long time. The need to construct a third main track to Clovis, New Mexico, where the Midwest and Texas routes are going to, may be another option to alleviate the trainload to central states, but BNSF may go their own separate way.

3.4 Comparison of Hiland Cutoff and Interchange Agreements

The aforementioned UPRR Cajon Pass rail line offers the opportunity of routing trains through Colton and hence directly to the Port of Long Beach. The trains would operate over BNSF tracks between Daggett and Silverwood where they would crossover to the UPRR line. This connection crossover is constructed such that a train can move from south to north or north to south. However, the movement of a train from north to north (or south to south) is not possible, as there is no connecting crossover for such train movement. If a new connection track between BNSF and UPRR is to be constructed, a train can operate from Summit (named Hiland on UPRR) over the UPRR line to Palmdale and thence to Los Angeles on the Southern California Regional Rail Authority (SCRRA) line. The SCRRA line can connects to the Alameda Corridor near downtown Los Angeles. UPRR has operating rights over the SCRRA line. During the times of extreme congestion, this routing option could have viability for moving freight to the Port of Long Beach.

The line combination could also be used for routing trains to San Diego. An interchange of trains from UPRR to BNSF would take place at Commerce, CA, and be operated from there to San Diego by BNSF.

The SCRRA line routing option is circuitous relative to the Cajon Pass routes of UPRR and BNSF if the starting point is Victorville/Barstow. Freight Movements from Concord, CA, to the Port of Long Beach would be logically routed over the SCRRA line.

3.5 Military Equipment to San Diego via BNSF

BNSF Railway exclusively serves the Port of San Diego. In a practical sense, it has the only routing option. The San Diego freight line which BNSF operates over is owned by Orange and San Diego Counties. BNSF sold the line but as with the UPRR sales noted above, the seller retained the exclusive right to operate freight service. The BNSF trains can operate on the San Diego Line to Placentia where they may connect to a Transcontinental line for direct service to Barstow.

Near the Port of San Diego, BNSF can connect to a short line railroad. Theoretically, but not practically, through this shortline connection, traffic could be routed to the UPRR via two privately owned shortlines. Interchange between the shortline and UPRR will take place in the Imperial Valley. This route can take the military traffic into Mexico where it will enter at Tijuana and operate through to Tecate, before re-entering the U.S.

After connecting to the UPRR in the Imperial Valley, the route will be to Niland and connection to the El Paso Line. UPRR can operate over the El Paso Line to Colton, then on its Cajon Pass route to Summit where is will crossover to the BNSF Line.

The report recognizes the potential conflict between passenger and freight train service on the San Diego line. The trains to/from San Diego will have to be fleeted during the night time hours to avoid conflicts with street car operations, passenger trains, and AMTRAK service. The system will be challenged to operate freight trains on 30 minute headways. The departure preparation for a train (air brake tests, etc.) is time consuming and given the limited staging area in San Diego will make things more difficult. In fact, the train staging capacity shortfall at San Diego will generate some daunting operational issues.

If Surge Sustainment trains operating on the BNSF to the Port of Long Beach occur at the same time as San Diego operations do, the on-time performance of all trains between San Bernardino and Atwood will be degraded. For that reason, it may be prudent to operate Surge Sustainment trains on UPRR's Cajon Pass line between Silverwood and the Port of Long Beach. An added benefit of using UPRR is to access ICTF. If the docks are backed up, the trains can be operated to/from ICTF. This will entail a short truck dray of four miles.

3.6 Nebo/Yermo NTC and DLA Retrograde Through San Diego

The trackage rights that UPRR has over BNSF-owned track between Daggett and West Riverside are 'full' rights. This means that UPRR can serve all industries situated along the line, and operate both freight and passenger trains. The access switch to Nebo is situated on the line. Thus, both UPRR and BNSF can directly serve the base. Such is not the case at Yermo, where the turnout switch to the Yermo storage tracks is from the UPRR's Las Vegas line. BNSF does not have operating rights on the UPRR line. All freight traffic entering and departing Yermo must be switched to UPRR. It is common for DoD to use BNSF as the line haul carrier. Placement into Yermo requires an interchange of traffic from BNSF to UPRR. The interchange normally takes place at Barstow. As such, the interchange adds an additional tier of cost and time for BNSF.

The BNSF rail line is situated on the south side of the Marine Corps Logistics Base at Yermo. Based on a field inspection of the physical property, it indicates that a connection track between the BNSF main line and the storage tracks inside the base could be made. Engineering feasibility work to test this assumption should be conducted. If the track is constructed, the Yermo base could be directly served by both BNSF and UPRR. This will eliminate the need to interchange traffic between the two railway carriers. A further analysis might be necessary to examine the cost/benefit of constructing the connecting track relative to maintaining the status quo. An added benefit is that the main line of BNSF could be used to move rail cars between Nebo and Yermo.

3.7 Railroad Operations between San Pedro Bay Ports and Barstow/Yermo

UPRR operates over the tracks owned by BNSF between Daggett and West Riverside. At Daggett and beyond, (toward Las Vegas) UPRR operates on its own track. At West Riverside, UPRR connects to its own main line track (The Los Angeles Subdivision) and can operate into Los Angeles on this route. This route provides connectivity to the Alameda Corridor near 9th Street in Los Angeles.

UPRR also owns and operates another east/west rail line (Alhambra Line) in the Los Angeles Basin. The line's western terminus is at the Los Angeles River, across from the Los Angeles Union Passenger Depot. The Alhambra Line is sometimes referred to as the El Paso Line. Trackage owned by the SCRRA (over which UPRR has operating rights) connects the Alhambra Line to the Alameda Corridor near 9th Street in downtown Los Angeles.

A third routing option between the San Pedro Bay Ports and Barstow is to Palmdale on the SCRRA owned lines which connect to the Alameda Corridor. As the former owner of the SCRRA rail lines, UPRR has exclusive freight operating rights (retained at the time of sale). At Palmdale, the SCRRA Line connects to UPRR's Palmdale – Colton route. In turn this line is in close proximity to the BNSF Transcontinental Line (in this section of track UPRR has operating rights on BNSF) near the summit of the Cajon Pass. Using access tracks, trains can transfer from the UPRR to BNSF Line near summit. A new connector track would need to be constructed.

In connecting the Ports to Barstow, BNSF has one routing choice, which is on the Transcontinental Line. Because of the heavy train volume (100 trains a day) in the Cajon Pass, BNSF is currently constructing a 3rd track between San Bernardino and Summit, which will be completed by the end of 2007.

UPRR has three routing choices between the Ports and Barstow. Their trains could (1) operate over the Los Angeles Subdivision to West Riverside, then continue on to Barstow over BNSF trackage, (2) use the Palmdale option noted above, or (3) use the Alhambra Line to Colton and operate over its own line in the Cajon Pass (the Palmdale – Colton Line) crossing over to the BNSF at Summit for further movement to Barstow. This latter routing option (3), could be further refined in the LA Basin. UPRR could route their trains between the Alameda Corridor and Pomona on the Los Angeles Subdivision, and crossover to the Alhambra Line for movement to Colton. UPRR will complete the construction of a second main track between Pomona and Colton by the end of 2008. The route segment of the Los Angeles Subdivision between Pomona and Los Angeles is already double tracked.

The Alameda Corridor provides connectivity between the Ports of Long Beach/Los Angeles and the transcontinental rail lines of UPRR. BNSF's Transcontinental rail line connects to the Alameda Corridor (thence to the San Pedro Bay Ports) at the same point as does UPRR.

Both BNSF and UPRR have non-discriminating rights to operate on the Alameda Corridor and on all port-owned tracks and facilities. This means that neither railway carrier has competitive access superiority to the other. For example, if a shipment is to originate at any Port facility on Terminal Island, both railway carriers will have non-discriminatory access to that port generated rail traffic. As noted above, the right to equal access applies to all port facilities, and not just those situated on Terminal Island.

However, UPRR has exclusive access to the Yermo Marine Corps Logistics Base. This means that final delivery must be made through the UPRR. If the line haul is by BNSF, the interchange to UPRR would take place at Barstow. Based on a field trip to the Yermo Marine Corps Logistics Base, an early thought is that the Base can be connected to BNSF's Transcontinental route by the construction of a new connector track (rail spur track). If the new spur is

constructed, the Ports of Long Beach and Los Angeles can be connected to the Yermo Base by a single line haul billing on either UPRR or BNSF.

At the present time, most military equipment moving by rail to Yermo (from any point in the Western U.S.) is line-hauled to Barstow by BNSF. The railcars are then interchanged to UPRR for delivery to the Base. This may add a layer of unnecessary expense to military shipments relative to direct haulage to the Base by the line haul railroad. The savings in transportation costs may produce a benefit which would offset the expense of constructing the new spur track between the Base and BNSF Transcontinental Line.

Another feature of direct delivery of rail hauled traffic is related to the timeliness of shipments. The interchange of rail traffic from BNSF to UPRR at Barstow can add one or more days to transit times. If an interchange of railcars from one railroad to another can be avoided, transit times can be reduced. If both UPRR and BNSF have direct access to the Yermo Base, then both line-haul carriers would be in a position to make direct deliveries of rail cars to the facility.

4.0 RAILROAD INTERMODAL OPERATIONS

The San Pedro Bay Ports of Los Angeles and Long Beach are the largest port complex in the United States as measured by container volume. Approximately 43% of all twenty foot equivalent container units (TEU's) are transported into or out of the region by rail. These containers are direct ship-to-rail movements where the goods are transported to destination in the waterborne container. An additional twelve to fifteen percent of the waterborne container cargo is shipped out of the region by rail after being locally warehoused or transloaded.

There are three commonly used terms to describe rail intermodal operations as it relates to the point of transfer from ship to rail:

1. On-dock is used to describe the transfer of a container from ship-to-rail at the port.
2. Near-dock is an intermodal facility situated within five miles of the port.
3. Off-dock refers to a facility situated more than five miles from the ports.

4.1 Intermodal Facilities in Los Angeles Basin

The San Pedro Bay Ports are populated with 10 on-dock intermodal rail loading facilities. The facilities situated on the Terminal Island are world class. Four of these are in the Port of Los Angeles and one in the Port of Long Beach. Except for the K-Line (ITS) facility in the Port of Long Beach, the other port intermodal facilities are inadequate due to design and/or size. Two steamship companies (Mitsui and Hyundai) do not have on-dock intermodal rail facilities and that of OOCL is seldom used because of design and terminal size. The loading track area at the OOCL Terminal is usually stacked with grounded containers. Two of BNSF Railway's five largest customers at Hobart Yard are Hyundai and OOCL, accounting for more than 250,000 containers annually. Approximately 23% of all container TEU's passing through the San Pedro Bay Ports are loaded on dock. The ports expect this percentage to increase to 30-35% over the next several years provided the master plans of both ports are actualized.

There is one near-dock rail operated facility in the region. It became operational in 1986 and is named ICTF (Intermodal Container Transfer Facility). UPRR has the exclusive right to operate ICTF. ICTF has a capacity limitation of 850,000 containers annually and will have throughput of about 700,000 containers in the calendar year of 2006. UPRR is planning to double the capacity of ICTF in the next few years.

BNSF Railway is in the process of developing its own near-dock facility. This project is named SCIG (Southern California Intermodal Gateway). It is expected to be operational in late 2009, and when at full operation this SCIG capacity will be capable of handling 1.5 million containers annually.

There are five off-dock rail intermodal facilities in the Los Angeles Basin. Three are operated by UPRR and two by BNSF Railway. Each of these facilities handles a mixture of both domestic and waterborne container cargo. Most of the marine containers not loaded on-dock or near-dock pass through Hobart Yard (BNSF) or East Los Angeles Yard (UPRR). Both of these facilities are situated in the City of Commerce/Vernon area near downtown Los Angeles. The other three

off-dock rail facilities are primarily used for loading domestic containers or trucks. As measured by volume, Hobart Yard is easily becoming the largest facility of its kind in the United States. In the calendar year of 2006, Hobart will have volume exceeding 1.4 million units. Of this, about 800,000 units will be waterborne containers.

4.2 Railroad Operations in San Pedro Bay Ports

In 1997, the Class I railroads serving the ports established a short line switching carrier, called Pacific Harbor Line (PHL). PHL maintains the port track, dispatches trains in the Port Complex, and switches the carload traffic of BNSF and UPRR. In a transaction to use PHL, two railway carriers must be reserved to handle all unit trains to destination. This reservation includes all intermodal traffic.

PHL is provided with a 'per car' switching allowance to serve the carload customers of the railway carriers. Carload traffic refers to the transport of goods in tank, gondola, box, flat, automobile, covered hopper cars, etc.

In practice, BNSF and UPRR have contracted a lot of the switching work associated with intermodal operations in the ports to PHL. To underscore the point, PHL operates about 30 engine shifts each day, but only five of those are engaged in carload switching. The railway carriers contract directly with PHL engine work shifts. This arrangement is a scheme of outsourcing work. However, in some instances, the railway carriers will operate intermodal trains to or from the docks without using PHL to yard or assemble the train. The determining decision maker is the intensity of the switching work relative to the amount of time required for the line haul movement to the next crew change point.

4.3 Evolution of Railroad Intermodal Operations and Block Swapping Trains in the Ports

The first intermodal facility constructed in the ports was the one serving K-Line. It opened in the late 1980's.

Railroad business rules have changed substantially with the passage of time. In the early days of on-dock container loading, the railway carriers insisted on an operation of trains loaded from a single point of origin going to a single destination. Each had to consist of a minimum number of containers. This sometimes meant that the marine terminals had a backup of cargo awaiting transport by rail. The shipping company had the option of draying the container to a railway carrier's facility where it would be consolidated with other marine and domestic containers. This consolidation provided the volume necessary to operate a full-sized train tailored to the physical plant of the railroad. Further, the early on-dock marine terminals did not generate the critical mass required for a daily operation to eastern destinations. Containers being held for custom's clearance and other reasons might miss the weekly scheduled on-dock service, and end up with being truck-drayed to a rail facility rather than wait for the next week's train. Today, the railway carrier operated intermodal facilities offers daily service to most eastern intermodal markets. These facilities generate the critical mass of containers needed to provide daily service by consolidating traffic from all international and domestic customers.

Some of the railroad business practices have changed because their own intermodal facilities are near capacity. This has caused them to be more flexible in the imposition of rules at the on-dock train makeup sites.

The evolution of on-dock railroad which has imposed various loading rules is summarized as follows:

1. Solid trains from one point of origin to one destination.
2. Multiple points of origin to one destination.
3. Multiple points of origin to multiple destinations.
4. Small numbers of containers consolidated with traffic from a near dock facility (ICTF).

In each case, the consolidation has increased the required switching frequency to assemble a train. This has increased train congestion in the ports, and the capacity in the port complex is becoming an issue to both railway carriers and shipping companies. As of 2005, BNSF commenced operating a train no less than 8,000 feet in length. This arrangement has backed up rail containers onto the docks, and relief may come from a form of consolidating traffic. However, the consolidation is taking place in the port complex. The number of containers may be small from each terminal; so forming a solid destination train will be time-consuming.

The next business model that the railway carriers will employ is the one where multiple block trains will be purified for operation to eastern markets outside the port complex. This work will take place where the 'dirt is cheap'.

The final evolution of the on-dock railroad business model will be the one where containers are randomly loaded on railcars regardless of the destination. They will be transported to a facility where they are lifted again. Through this process, the trains will be purified as to destination. This concept is sometimes referred to as the 'Agile Port' concept. The railway carriers have not yet adopted this business model because it will add a new tier of costs to their transportation product. In addition to the cost of constructing a facility for this process, the lift costs of operating the facility will be in the range of $60 or more per container. If the same operation is replicated for westbound movements, there would be an equivalent expense. The size of the facility would be hundreds of acres, perhaps as many as 1,000 and both railway carriers will have separate facilities as they do not operate jointly beyond Daggett. For UPRR, a joint-used facility along the BNSF corridor is not a strategic investment. That is because the route through Victorville/Barstow is not its primary intermodal route. Barstow is 'out of route' for planned intermodal operations. UPRR plans to operate its intermodal and automobile service through El Paso. In that context UPRR has DoD approval to spend $1.5 billion for completion of a double track route over the next several years. This investment will make UPRR competitive with BNSF for rail shipments from Southern California to eastern destinations.

4.4 Victorville as a Forward DoD Staging Area

BNSF plans to construct an intermodal facility at Victorville. This facility could be synergistically linked to use by the DoD. BNSF does not plan to construct any outside support tracks. They plan to follow the Hobart and SCIG planned business model where trains are

slotted into the intermodal facilities from main line staging areas. For example, trains are slotted into Hobart Yard from a 3rd main track in the Prado Dam area (east of Corona). Part of this staging is related to passenger train operations from Orange County. During the time of passenger train operations, trains entering Hobart cannot be slotted in the track segment between Fullerton and the yard without negatively impacting the passenger train service. In the case of Victorville, BNSF would slot trains destined for Victorville on a 3rd main track, east of Barstow.

The forward staging of military equipment at Victorville means that multiple thousands feet of storage track will need to be constructed. From those storage tracks, ship loading plans can be assembled for delivery by rail. For example, if the ship stowage plan is to load a particular segment of military equipment first, then a train of that equipment can be assembled at Victorville, filling out on the next equipment loading plan, etc. This would reduce the amount of coordination at the marine terminal. The Victorville staging area would reduce travel time to port deployment to hours, not days.

The military staging tracks at Victorville can serve dual purposes. They will be infrequently used by DoD and when used, for short durations of time. Therefore, the storage tracks could be utilized by BNSF (or UPRR) for a block swapping scheme as previously described. The railway carriers would pay DoD a rental amount for this use. This use would facilitate the marine terminal turnover of inventory more quickly. In turn, this would promote greater TEU throughput at the ports by relieving congestion at the docks.

In 2005, the TEU throughput per acre at the San Pedro Bay Ports was 4700. It is expected that the TEU throughput in 2025 needs to be between 11,000 and 13,000 to handle the demand side of anticipated growth. The actual throughput is dependent on marine terminal configuration. This dynamic is related to ship berths, rail loading facilities, and business rules.

5.0 FINDINGS OF THE SIMULATION RUNS

5.1 Results of Simulating Current and Near-Term Commercial Traffic

Perhaps the most serious stretch of traffic congestion along the routes of the surge deployments is Cajon Pass. All Amtrak, UPRR and BNSF trains between Barstow/Victorville and Los Angeles/San Diego must use the two-main-track BNSF line from Barstow as far west as Silverwood, near the summit. Although there are three tracks down the south slope of Cajon Pass from Silverwood to Keenbrook, they cannot be flexibly utilized. Only UPRR trains routed via the UPRR Alhambra Line have the option of using the UPRR Palmdale Line from Silverwood down the west slope of the Pass and into West Colton. All other trains must use the two-main-track BNSF line via Verdemont and San Bernardino. As a result, the BNSF tracks on Cajon Pass are much more heavily utilized than the UPRR Palmdale Line. One track of the BNSF Line is constructed on a 2.2% gradient (like the UPRR Palmdale Line); the other is on a 3% gradient. Downhill trains using the 3% track are ordinarily required to maintain a thirty-minute spacing for safety reasons. From Verdemont to San Bernardino the BNSF line has a third main track (opened in 2004), and construction of a third main track from Verdemont to Silverwood/Summit is planned by BNSF for completion about 2008. In the meantime, heavy traffic levels render transit times on Cajon Pass relatively volatile.

Starting from a Year 2000 base of 4 Amtrak movements and 94 through freight train movements per peak day[9], simulations were conducted for scenarios incrementing the freight traffic between Colton/W. Colton and Barstow by 10%, 15%, 20%, 25%, 30%, 35%, 40%, 45%, 50%, and 55%. Year 2006 rail traffic on Cajon Pass is approximately the same as the Base + 20% scenario. Results are displayed in Figures 6 and 7. Figure 6 displays average transit times and Figure 7 displays the ninety-eighth percentile of peak-day transit times (mean plus two standard deviations). The figures show transit times when these traffic volumes must be accommodated on existing (2006) main-line trackage. The "3-flex" data points correspond to a hypothetical case where a new connection between the BNSF Line and the UPRR Palmdale Line is implemented in the vicinity of Keenbrook – Devore Road, permitting completely flexible use of all three tracks on the south slope of Cajon Pass by all Amtrak, BNSF and UPRR train movements. This hypothetical alternative assumes traffic control and other institutional arrangements are made to allow this more efficient usage of available track capacity.

As may be seen, without triple track, the mean and 98th percentile of transit times begin to deteriorate seriously as traffic levels rise above Base + 20-25% (i.e., as they rise above Year 2006 levels). Implementation of fully-flexible triple-track operation is able to sustain reasonable transit times until a Base + 40% level of traffic (this is about Year 2010 forecasted traffic). Beyond that, transit times grow rapidly and become extremely volatile. To accommodate traffic levels in Year 2010 and beyond with transit times comparable to Year 2000, at least four main tracks on the south slope of Cajon Pass are required.

[9] A peak-day is defined as one hosting the 90th percentile of the distribution of daily train movements.

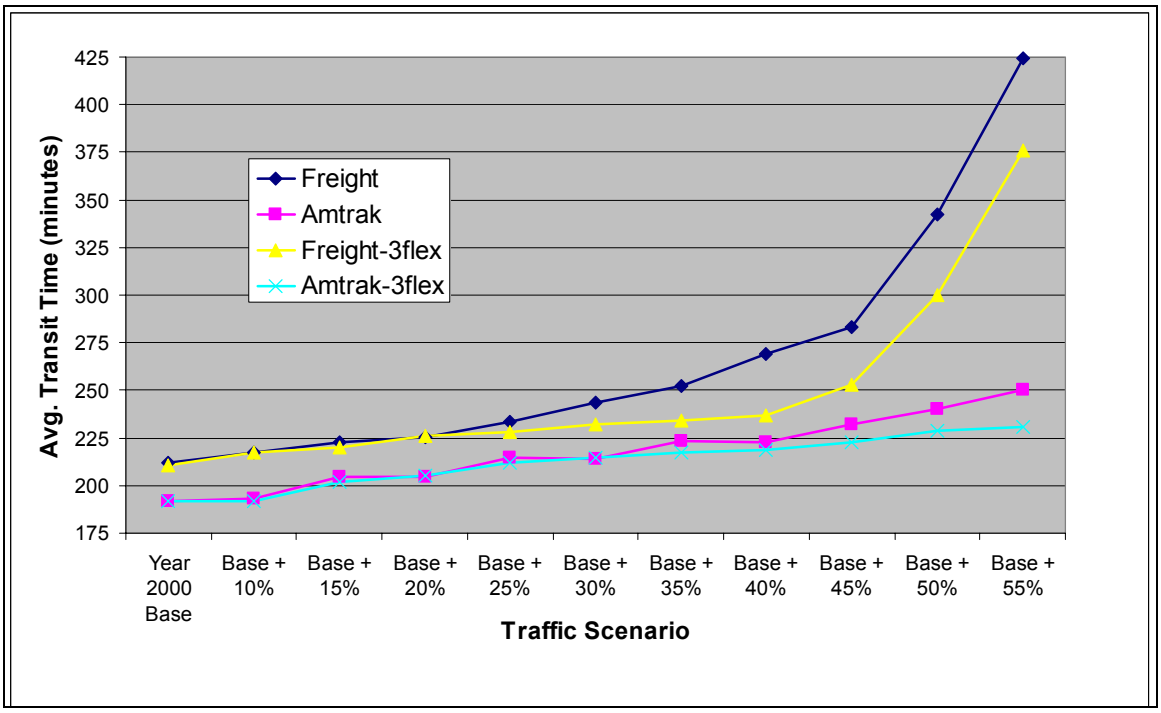

Figure 6. Average Transit Times, Barstow – Colton Crossing, Existing (2006) Infrastructure

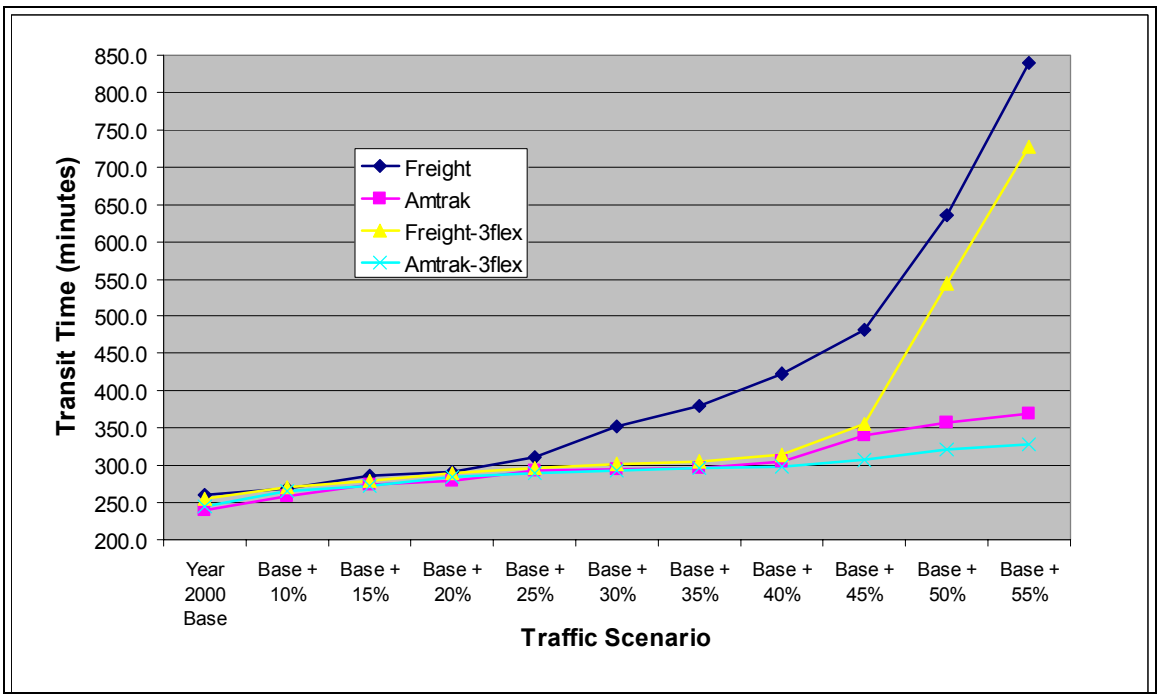

Figure 7. Ninety-Eighth Percentile Transit Times, Barstow – Colton

5.2 Results of Simulating Surge Deployments Overlaid on Commercial Traffic

Considering the foregoing results of simulations without overlay of surge deployments, it is not meaningful to simulate the military movements juxtaposed on future-year commercial traffic levels unless a major program of rail infrastructure improvements is included.

Three scenarios of commercial traffic and rail infrastructure were simulated with the overlay of the military surge deployments, summarized as follows:

1. 2006 Scenario – Existing traffic and rail infrastructure.

2. 2010 Scenario – 2010 forecasted commercial traffic levels. Trackage improvements incorporated in the simulation include the following:

    - Three main tracks on BNSF Line Redondo Jct. – Fullerton, Atwood – Colton – Barstow
    - Two main tracks on UPRR San Gabriel Line Riverside – Redondo Jct.

3. 2025 Scenario – 2025 forecasted commercial traffic levels. Trackage improvements incorporated in the simulation include the following (in addition to 2010 improvements):

    - Four main tracks on BNSF Line Redondo Jct. – Fullerton and Riverside – Barstow. Flying junctions at Riverside/Colton and grade separation of Colton Crossing.
    - Two main tracks on UPRR Alhambra Line Pomona – Yuma Jct. Flying junction at West Colton

Even these ambitious improvements are not sufficient to enable Year 2000 average transit times and Year 2000 reliability of transit times. The 2005 SCAG study determined the following additional improvements would be necessary to enable Year 2000 rail service quality:

1. 2010 – Fourth main track on BNSF Line San Bernardino – Silverwood/Summit. The total 2010 improvements recommended in the SCAG study would cost an estimated 1.1 billion 2004 dollars.[10]

2. 2025 – Fifth main track on BNSF Line Cajon – Silverwood/Summit. The total 2025 improvements recommended in the SCAG study would cost an estimated 1.1 billion 2004 dollars beyond the expenditures for Year 2010.[11]

Figure 8 summarizes results for Surge Sustainment and Stryker Brigade deployments. As may be seen, before rail capacity improvements and under 2006 traffic levels, mean transit time is about 8 hours, and the 98th percentile is about 10.6 hours. In both 2010 and 2025 scenarios,

[10] *Inland Empire Main Line Rail Study Final Report*, prepared for Southern California Association of Governments, Contract 04-010, June 30, 2005.
[11] *Inland Empire Main Line Rail Study Final Report.*

mean transit time drops to less than 7 hours and the 98th percentile drops to about 8.8 hours. Thus the proposed improvements would reduce surge deployment transit times and make them more predictable in spite of the strong growth in commercial traffic.

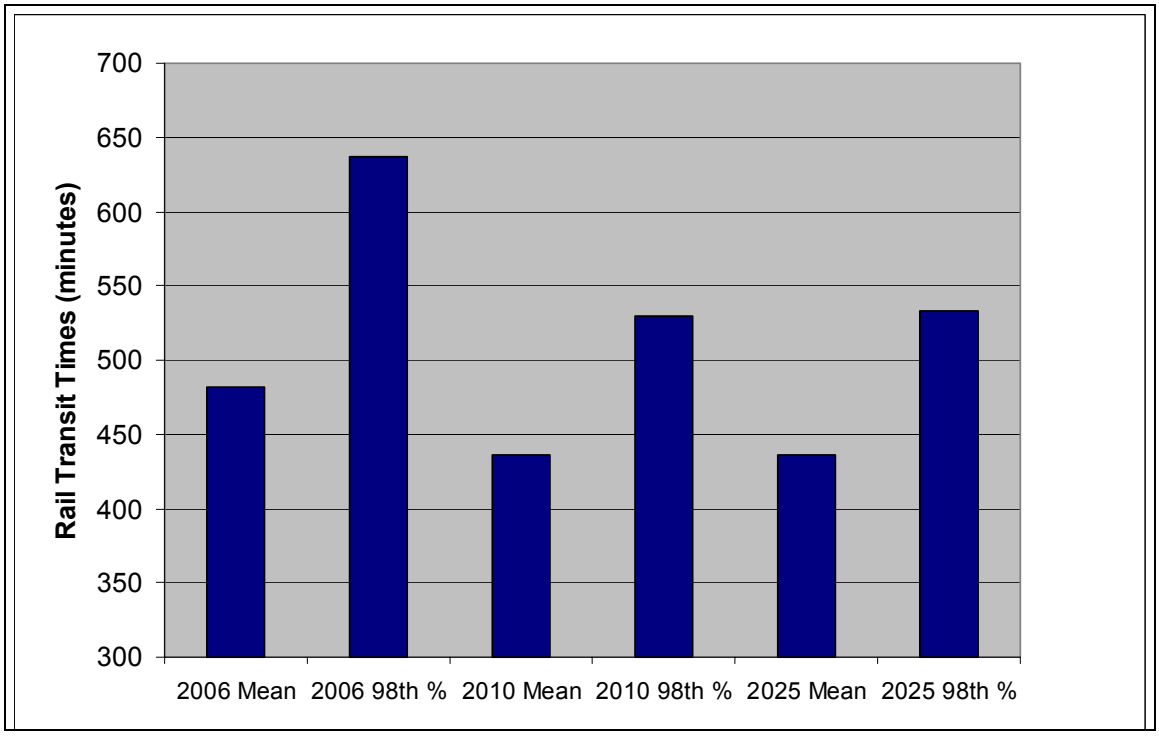

Figure 8. Mean and Ninety-Eighth Percentile of Surge/Stryker Transit Times – 2006, 2010, and 2025

Figure 9 summarizes results for the notional military force deployments (NMFD) en route to the Port of San Diego (modeled as far as Atwood from Barstow). Before rail capacity improvements and under 2006 traffic levels, mean transit time as far as Atwood is about 6.5 hours, and the 98th percentile is about 9 hours. In both 2010 and 2025, mean transit time drops to 5.5 hours while the 98th percentile drops to about 7.5 hours in 2010, then rising to about 8.3 hours in 2025. As with the other deployments, the proposed improvements reduced the notional surge deployment transit times and make them more predictable in spite of the strong growth in commercial traffic.

Tables 2 and 3 provide more detail concerning simulation results for the 2006, 2010 and 2025 scenarios. Shown are mean, standard deviation and 98th percentile of simulated transit times for Amtrak, BNSF, UPRR and military trains operating over BNSF and UPRR main lines between Barstow and Redondo Junction.

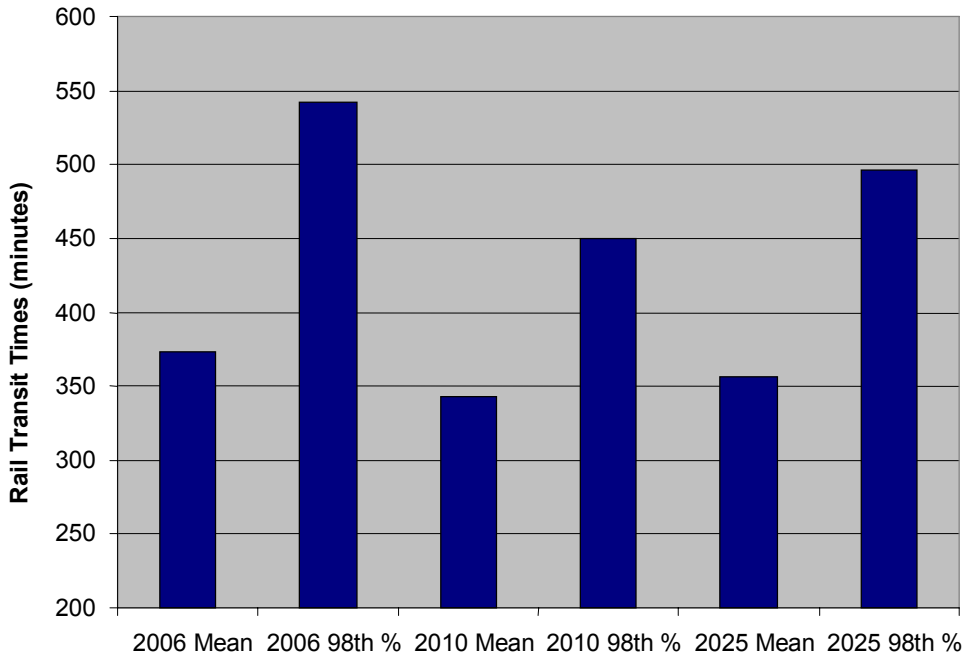

Figure 9. Mean and Ninety-Eighth Percentile of Mechanized Brigade Transit Times - 2006, 2010 and 2025

Table 2. Simulated Transit Times (Minutes) for the Surge Sustainment or Stryker Brigade Deployments

		2006 Scenario			2010 Scenario			2025 Scenario		
		Mean	SD	98th %	Mean	SD	98th %	Mean	SD	98th %
Barstow – Colton	Stryker	252	57	366	242	41	324	234	42	318
	BNSF	245	48	341	243	46	335	240	43	326
	UPRR	257	58	373	253	44	341	255	54	363
	Amtrak	204	29	262	241	90	421	205	75	355
Colton - Redondo	Stryker	153	51	255	117	19	155	125	20	165
	BNSF	154	66	286	118	21	160	130	32	194
	UPRR	140	54	248	115	26	167	117	23	163
	Amtrak	58	24	106	55	26	107	60	13	86
Redondo - POLB	Stryker	77	13	103	77	13	103	77	13	103
	BNSF	77	13	103	77	13	103	77	13	103
	UPRR	77	13	103	77	13	103	77	13	103
Total Route	Stryker	482	78	637	436	47	530	436	48	533
	BNSF	476	83	641	438	52	542	447	55	557
	UPRR	474	80	635	445	53	550	449	60	569
	Amtrak	262	38	337	296	94	483	265	76	417

Table 3. Simulated Transit Times (Minutes) for the Notional Surge Military Force Deployment

		2006 Scenario			2010 Scenario			2025 Scenario		
		Mean	SD	98th %	Mean	SD	98th %	Mean	SD	98th %
Barstow – Colton	NMFD	262	68	398	255	50	355	265	68	401
	BNSF	251	55	361	257	57	371	256	59	374
	UPRR	262	58	378	269	58	385	270	62	394
	Amtrak	220	33	286	260	247	754	203	42	287
Colton - Redondo	NMFD	111	50	211	88	19	126	91	17	125
	BNSF	153	63	279	119	23	165	127	27	181
	UPRR	142	55	252	115	26	167	116	22	160
	Amtrak	59	20	99	54	13	80	59	7	73
Total Route	NMFD	373	84	542	343	53	450	356	70	496
	BNSF	404	84	571	376	61	499	383	65	513
	UPRR	404	80	564	384	64	511	386	66	518
	Amtrak	279	39	356	314	247	809	262	43	347

Note: Statistics for notional military force deployment (NMFD) movements are for the Barstow – Atwood segment only.

6.0 CONCLUSIONS AND RECOMMENDATIONS

6.1 Solutions on Intermodal Operations and Block Swapping

The container loading procedures from ship to rail or yard in SOCAL are summarized in Table 4:

Table 4. Summary of Intermodal in SOCAL

Types	Descriptions	Locations
On-dock	Ship to rail	10 facilities in San Pedro Bay Ports
Near-dock	Intermodal within 5 miles	1 ICTF owned by UPRR
Off-dock	Intermodal over 5 miles	5 locations in East L.A., City of Industry, San Bernardino

Over the years railroad business practices related to on-dock train makeup have become more flexible. Currently, the on-dock loading rules are as outlined below:

- Solid trains from one origin to one destination.
- Multiple origins to one destination.
- Multiple origins to multiple destinations.
- Small numbers of containers consolidated with traffic from a near dock facility (ICTF).

If a train is formed using block swapping techniques requiring a minimum number of containers, including more combinations of half-sized containers and shipments with various destinations to build the train would reduce terminal congestion. Current practices result in containers being held for the next scheduled train, which increase ocean terminal congestion. Shipping companies also have additional options for draying delayed containers to a railroad facility for consolidation with other marine and domestic containers. For example, a few options are:

- Providing the shipment volume necessary to operate a full-sized train tailored to the physical plant of the railroad.
- Employing truck-drayed service to a rail facility when containers miss a scheduled rail service.
- Using daily service offered by each intermodal facility to consolidate traffic from all international and domestic customers.
- Purifying the train consist for destination markets outside the port complex.

6.2 Recommended Practices on Choke Points and Interchanges

The BNSF Main Line traveling through the Cajon Pass is one of the most heavily used freight routes in the U.S. relative to capacity. Table 5 shows a Summary of Current Main Lines used by BNSF and UPRR.

Table 5. Summary of Current Main Lines and Trackage Rights

Segments	Carriers	From	To	Trackage
1	BNSF	Colton Crossing, West Riverside	Cajon, Devore	UPRR has trackage right
2	BNSF	Cajon, Devore	Silverwood/Summit	UPRR has trackage right
3	BNSF	Silverwood/Summit	Victorville	UPRR has trackage right
4	BNSF	Victorville	Daggett	UPRR has trackage right
5	UPRR	West Riverside	Palmdale	UPRR Palmdale line

The current choke points are:

Cajon Pass:

- For safety reasons, it is necessary to set up a self-imposed capacity limit, minimum half hour separation for westbound movements on the BNSF main line.
- There is a potential maximum flow of 48 trains per day through the Cajon Pass. Such a rail traffic restriction could cause high Average Waiting Time.

UPRR has the right to operate on BNSF's tracks. About 25% of the trains operating on this route segment are UPRR's. There are two connecting crossover tracks between BNSF main line and UPRR Palmdale line:

- Near Summit/Silverwood (north hill)
- Near Keenbrook/Devore (south hill)

BNSF does not have unrestricted rights to operate on the UPRR track. Although the UPRR Palmdale line has unused capacity, for competitive reasons UPRR will not grant BNSF a trackage right to operate over the line between Silverwood and Keenbrook. Therefore, BNSF is building a third track through the area. The current plan is to complete the third track addition between San Bernardino and Summit by the end of 2007.

6.3 Commercial Simulations in Cajon Pass

This study developed several commercial scenarios for simulation including four different train types and track configurations using 11 forecasted traffic levels starting with Year 2000 as the baseline and ending with the Year 2025 forecasted container import level. Table 6 shows all commercial scenarios and data rates.

Table 6. Summary of Commercial Train Numbers and Incremental Rates

Train Types	Base 2000	Rate	Rate	Rate 2006	Rate	Rate	Rate	Rate 2010	Rate	Rate	Rate 2025
Freight	94*	10%	15%	20%	25%	30%	35%	40%	45%	50%	55%
Amtrak	4*	10%	15%	20%	25%	30%	35%	40%	45%	50%	55%
Freight/ 3 Tracks	94*	10%	15%	20%	25%	30%	35%	40%	45%	50%	55%
Amtrak/ 3 Tracks	4*	10%	15%	20%	25%	30%	35%	40%	45%	50%	55%

* Train numbers

Simulation routes are extended from Colton Crossing and West Colton on the south to Hiland and Victorville on the north, including all existing trackage over Cajon Pass. Several line segments are involved as displayed in Table 5, each featuring different levels of congestions.

These simulation runs conclude:

1. The average transit times begin to deteriorate seriously as traffic levels rise above Base + 20-25% (i.e., as they rise above the Year 2006 levels).
2. With three tracks implemented, the train ride is able to sustain reasonable transit times until a Base + 40% level of traffic (this is about Year 2010 forecasted traffic).
3. Beyond Base +40% level (Year 2010), transit times grow rapidly and become extremely volatile.
4. To accommodate traffic levels in Year 2010 and beyond with transit times comparable to Year 2000, at least four main tracks on the south slope of Cajon Pass are required.

6.4 Military Simulations in Cajon Pass and San Diego

The military deployment is to use double-stacked container cars and chain tie-down cars overlaid on the commercial train movements. Two scenarios with three levels of incremental rates are outlined as Table 7:

Table 7. Summary of Military Train Numbers and Incremental Rates

Train Types/ Routes	Base 2006	Rate 2010	Rate 2025
Surge and Stryker/ Victorville – POLB	2 + Commercial 20%*	2 + Commercial 40%*	2 + Commercial 55%*
Notional Military Force Deployment/ Victorville – Atwood	4 + Commercial 20%*	4 + Commercial 40%*	4 + Commercial 55%*

*Extracted from Table 6

The military simulation runs of Surge Sustainment and the Stryker Brigade Deployment scenarios conclude:

1. Under the 2006 traffic levels, mean transit time is about 8 hours, and the 98th percentile is about 10.6 hours.
2. In both 2010 and 2025 levels, mean transit time drops to less than 7 hours and the 98th percentile drops to about 8.8 hours.
3. The following track implementations are strongly recommended:

    - In 2010, increase track number to three from Victorville to POLB.
    - In2025, increase track number to four from Victorville to POLB.

The notional military force deployments (NMFD) en route to the Port of San Diego (modeled as far as Atwood from Barstow) conclude:

1. Under the 2006 traffic levels, mean transit time as far as Atwood is about 6.5 hours, and the 98th percentile is about 9 hours.
2. In both 2010 and 2025, mean transit time drops to 5.5 hours while the 98th percentile drops to about 7.5 hours in 2010, then rising to about 8.3 hours in 2025.
3. As with the other deployments, the proposed improvements reduced the notional surge deployment transit times and make them more predictable in spite of the strong growth in commercial traffic. Following implementations are strongly recommended:

    - In 2010, increase track number to three from Victorville to San Diego.
    - In2025, increase track number to four from Victorville to San Diego.

The envisioned military surge deployments must contend with heavy commercial rail traffic for limited track capacity. Even without the presence of the surge military movements, rail transit times in Southern California are increasing and becoming more volatile. For surge deployments overlaid on year 2006 traffic levels operated on existing trackage, there would be about a four-hour difference between mean and 98th percentile of origin-to-destination transit times for surge deployments operating under ordinary dispatch priority. Reducing this variability would require assignment of unusual priority to the military trains, thereby resulting in unusual delays to commercial operations.

The need for main line track capacity improvements in Southern California is recognized by both public agencies and the private railroads, and some (but not all) of the required improvement projects are now under construction or in the planning process. If the 2010 and 2025 Scenario improvements analyzed in this report are implemented on time, the speed and reliability of both military surge deployments and commercial traffic will be significantly improved compared to current capabilities, in spite of continued strong growth in commercial traffic. About one hour can be reduced from mean transit times, and, perhaps more importantly, about 1 – 1.5 hours in variability of transit times can be eliminated.

The track capacity improvements to accommodate Year 2025 traffic levels with Year 2000 transit times and transit time reliability cost about 3.2 billion 2004 dollars. There is considerable risk concerning whether or not the public agencies and the relatively low-rate-of-return private railroads can make the investments and implement them quickly enough to enable the military deployment capabilities simulated herein.

APPENDIX A. DOCUMENTATION OF INPUT AND OUTPUT FILES

Input files are listed and documented in alphabetical order here. Documentation of the output file follows.

(a) "dedicateTrack.dat"

This file defines the dedicated nodes and routes. The dedicated settings for the route and node restrict the possible path for a train, and can be used to force the trains in a given route to only run through a specific path.

A node can be set to either '0' or '1' or nothing. If a node is set to '0', it means that all the trains which run on a dedicated route (set as '0' or '10'), can run through this node only from port 0 to port 1. If a node is set to '1', it means that all the trains which run on a dedicated track route (set as '1' or '11'), can run through this node only from port 1 to port 0. If a node is not set to any value in this file, this node is considered as a non-dedicated node. This node can be passed by a train moving from any direction.

A route can be set to '0', '1', '10', '11' or nothing. If a route is set to '0', then all the trains in this route can only take the dedicated node with '0'. If a route is set to '1', then all the trains in this route can only take the dedicated node with '1'. If a route is set to '10', then all the trains in this route can take either the dedicated node with '0' or non-dedicated node. If a route is set to '11', then all the trains in this route can take either the dedicated node with '1' or non-dedicated node.

The following is a sample file:

```
;define dedicated node
Node  908          0
Node  911          1


;define dedicated route
**    UA_YuRt      11
**    UA_RtYu      10
```

(b) "disruption.data"

This file is used to simulate that some resources are not available between the defined start time and end time. The file has the following format:

```
Location_ID    Start_day_number        Start_time    End_day_number    End_time
```

The location_ID must be mapped with a resource in the system file 'Mapping2Node.data'. The following is a sample file:

```
Junction_5        5                1233        6                1144
Track_6           4                1133        5                1144
```

The above data file indicates that junction_5 will not be available from 12:33 pm on the 5th simulation day to the 11:44 am of the 6th simulation day.

(c)"Mapping2Node.data"

This file maps a user-defined name to a name defined in the simulation system (such as track segment, junction, terminal station, train type, etc.).

The format of the file is:

User_Defined_Name Name_Used_In_Simulation

The following is a sample file.

```
20030313                1
20030314                2
TACOMABLAIR             UA_SG73_ST
```

The above file maps date '2003/03/13' to the first simulation day in the system and maps the station name 'TACOMABLAIR' to segment resource 'UA_SG73_ST', which is the segment resource defined for this station in the system.

(d) "name.dat"

This file is used to explain the abbreviations used in the system. The following is a sample file:

```
US          UP-San Gabriel line (Take BNSF from Riverside--Cajon/Yuma):
S2          UP-San Gabriel line (Take UP-Alhambra East of Pomona):
UA          UP-Alhambra line (Take all UP-Alhambra line)
```

(e) "param.dat"

This file stores all the parameters used in the simulation system. The contents of the current 'param.dat' file include:

```
REACTION TIME AFTER TRAIN STOPS (MIN)    = 2.0

NUMBER OF DIVISION BETWEEN STOP CHECKING
POINT AND THE END OF SEGMENT             = 4.0
```

(f) "priority.data"

This file is used to give priority to certain schedules. The format of the file is:

Terminal_Name Destination_Name Priority (Y or N)

The Terminal_Name and Destination_Name must be mapped to a name used in the simulation model in the file 'Mapping2Node.data'. If a terminal and destination pair is set to 'Y', then all the schedules with these origin and destination nodes will be set to the highest priority. If it is 'N', then no extra priority is given to this schedule.

A sample file is:

```
1314012BNSF  TACOMABLAIR      Y

1314012BNSF  TACOM            Y
```

(g) "route.dat"

Each route defines a specific path between an origin and a destination segment pair. The format is:

Route_Name Start_Track_Name End_Track_Name Visiting_Sequence_At_Each_Type_Of_Track

The visiting sequence at each type of track is used to lead the train to move in the correct direction. For example if it is 'U' in the column of 'SP', the trains in this route move through the 'SP' track in the ascend sequence. For example, the train can move from track SP_01_S to track SP_02_S. But it cannot move from track SP_02_S to SP_01_S. If it is 'N', the trains in this route cannot take any track of type 'SP' (tracks with the name starting with 'SP'). The following is a sample file:

```
;          *** ROUTE DATA FILE ***

; Route     Start Track       End Track   SP    AL    BN    AC    MT
; Name      Name              Name
; --------- -----------       ---------   ---   ---   ---   ---   ---
  SP1U      AL_SG0_DM         SP_SG1_ST   U     U     N     N     N
  AL1U      SP_SG2_DM         AL_SG4_ST   D     U     N     N     N
```

(h) "schedule.dat"

This file defines the dispatching train schedule. Each schedule consists of a train type, the number of routes in this schedule, and the name of each route. We allow each schedule to contain multiple routes. This is used to simulate passenger trains. For passenger trains, the path between two consecutive stops is represented as a single route. That is, if a schedule for a passenger train has four stops, it consists of three different routes.

Another issue in the schedule file is the departure time of the trains. We use two different methods. If 'Distribute number' is '1', it means that the departure time is based on a fixed time.

This is used for passenger trains. If 'Distribute number' is '2', it means that the departure time is random and follows a Poisson Process. This is used for freight trains. If the time range number is set to one, it means the departure times are sampled every simulated day. If it is set to two, then it would be every other simulated day and so on. The time range indicates the portion of the day the trains can depart and the last column in the data file indicates the average number of departures in this time range.

```
;Train          Route  Route            Distrib      Priority     Time range                Avg.
number of
;Name    #     Name           Number       Number                                        Trains
in this time range
;                                    (low:0 - 5)
;------- ------- ------- --------  ---------------  ---------- ------- -------  -------- ---------------
;0-1     UP-San Gabriel line:     Yuma <--->  East Yard (6,000' Intermodal)

FT_OIM  1   US_YuEy  2  0     1        00:00-23:59          1.3
FT_OIM  1   US_EyYu  2  0     1        00:00-23:59          1.3
```

(i) "speedLimit.dat"

This file stores the speed limit for each track segment or junction resource used in the simulation system as follows:

```
;                      *** Speed Limit Data File ***
;
;resource    SpeedLimit for      SpeedLimit for
;Name        passenger train     freight train
;             miles/hour           miles/hour
;--------    ---------------     --------------
 UA_SG1_T1      10                  10
 UA_SG1_T2      10                  10
 UA_SG1_T3      10                  10
```

(j) "train.dat"

This file stores the parameters for each type of train:

```
;                      *** Train Data File ***
;
;Train      Accel             Decel             Train       Max
;Name       Rate              Rate              Length      Speed
;          (feet/min**2)    (feet/min**2)      (feet)      (feet/min)
;solid waste
FT_WSW      1584              1584              4000        6160
FT_ESW      1056              1584              4000        6160
```

(k) "trains.data"

This file is used to expand the capability of the schedule data file. Previously, we had only two types of departure times: random (Poisson Process) or fixed schedule on each day. Now, this capability is expanded so that the departure time can be a different fixed schedule on each day. The file format is:

KeyID Terminal_Name Destination_Name Day_Number Departure_Time Train_Length

The Terminal_Name and Destination_Name must be mapped to a name used in the simulation model in the file 'Mapping2Node.data'.

The following is a sample file:

```
414     1314026BNSF     TACOMA          20030313    1805          2424
```

'414' is a primary key from a database record. We do not use it in our simulation.

Output file

The output file includes three different types of information.

(1) Detailed statistics on each schedule which includes (from left to right)

```
Schd ID
First Rt Name in the schedule
Train Type
Length of the Train
Total number of trains generated in the simulation
Average number of trains per day

Average length of route of this schedule (mile)
Standard deviation of the length of route
Minimal length of route of this schedule
Maximal length of route of this schedule

Average flow time (min)
Standard deviation of flow time
Minimal flow time
Maximal flow time

Average delay time (min)
Standard Deviation of delay
Minimal delay
Maximal delay


Average Length of Queue at the starting station for this schedule
Maximum Length of Queue at the starting station for this schedule
Average time for trains of this schedule waiting at the starting station.
Probability for the trains to wait at the starting station.
```

```
For example:
schd[0] US_YuEy FT_OIM  6000 147 1.30  63.44   0.31  62.89 64.97 102.50 189.48  85.99 163.29 16.18
189.10 0.00  76.97 0.004       2.00 3.15  0.45
```

(2) Detailed statistics on waiting for each schedule

For each node, it lists the average waiting time for all the stopped trains of this schedule at this node and the total number of trains of this schedule that passed through this node and how many of them stop at this node. For example, if it is 3.15 (66/147), it means that there are a total of 147 trains of this schedule passing this node and 66 of those trains stopped at this node. And the average waiting time for the stopped trains was 3.15 minutes.

(3) Detailed statistics on the node

```
*node ID
*Fraction of Occupied Time of this Node
*Fraction of Waiting Time of this Node
*Total of Trains passing this node
*Total of Trains that stop at this node while passing it
*P percentage of Trains that stops while passing this node
*Total number of trains enters from port 0 and leave from port 1 of the node
*Total number of trains enters from port 1 and leave from port 0 of the node
* Average waiting time for all the stopping trains at the node. (min)
* Standard Deviation of waiting time
* Minimal waiting time for all the stopping trains at this node.
* Maximal waiting time for all the stopping trains at this node.
```

APPENDIX B. SIMULATION INPUT AND OUTPUT FILES

Additions to the input data for 2005 SCAG study are defined herein. Output results for military train movements also are provided.

2005 – Surge Sustainment or Stryker Brigade

Additions to schedule.dat (North of Colton Crossing)

```
48-49 BNSF:             Barstow <---> Summit <---> San Bernarndino <--->
Alameda Corridor (6,000' Intermodal) - Stryker Brigade (08/21/2006)
  FT_OIMQ2  1     3     BB_BaSu
                        BB_SuSn
                        BB_SnRt                 2                 0
      1           00:00-23:59       2
  FT_OIMQ2  2     3     BL_RtSn
                        BL_SnSu
                        BL_SuBa                 2                 0
      1           00:00-23:59       2
```

Output.dat (North of Colton Crossing)

```
Freight Train   BNSF(Barstow-LA) Barstow -->Summit -->San Bernardino --
>Alameda Corridor ( 6,000 Intermodal Stryker Bridge scenario (Q type) )
schd[22]    BB_BaSu     FT_OIMQ2    6000  30      2.00                 84.76
0.00    84.76       84.76               273.68  76.09  187.44      600.69
           90.42  76.09    4.18      417.44               0.005    1.00
4.56     0.67

Freight Train   BNSF(LA-Barstow) Alameda Corridor -->San Bernardino -->Summit
-->Barstow ( 6,000 Intermodal Stryker Bridge scenario (Q type) )
schd[23]    BL_RtSn     FT_OIMQ2    6000  35      2.00                 86.76
0.00    86.76       86.76               229.33  25.43  188.05      287.85
           41.28  25.43    5.64       99.81               0.011    2.00
8.78     0.71
```

2006 - Notional Mechanized Infantry Brigade

Additions to schedule.dat (North of Colton Crossing)

```
BNSF:                    Barstow <---> Summit <---> San Bernarndino(main4) <--
-> Atwood(Carload) B1 cannot use main2 - San Diego Mechanized Division
(8/23/2006)
  FT_WCarL1 1     3     BB_BaSu
                        BB_SuC4
                        BB_C4At                 1                 0
      4           18:00-18:00       1.0

                  18:30-18:30       1.0

                  19:00-19:00       1.0

                  19:30-19:30       1.0
  FT_ECarL1 2     3     BL_AtC4
                        BL_C4Su
                        BL_SuBa                 1                 0
      4           04:30-04:30       1.0

                  05:00-05:00       1.0

                  05:30-05:30       1.0

                  06:00-06:00       1.0
```

Output.dat (North of Colton Crossing)

```
Freight Train   BNSF(Barstow-LA) Barstow -->Summit -->San Bernardino --
>AtWood ( West Carload - SD mechanized division (08/23/2006) )
schd[38]    BB_BaSu     FT_WCarL1   6500  80      4.00                 84.76
      -1.#J   84.76       84.76              282.83  93.66  189.20
641.63                101.36  93.66    7.73      460.16               0.010
1.00     3.54        0.56

Freight Train   BNSF(LA-Barstow) AtWood -->San Bernardino -->Summit --
>Barstow ( East Carload - SD mechanized division (08/23/2006) )
schd[39]    BL_AtC4     FT_ECarL1   6500  80      4.00                 86.76
      -1.#J   86.76       86.76              240.23  18.99  204.17
284.09                 36.06  18.99    3.65       79.92               0.027
2.00     9.65        0.65
```

2010 – Surge Sustainment or Stryker Brigade

Additions to schedule.dat (North of Colton Crossing)

```
BNSF:              Barstow <---> Summit <---> San Bernarndino <---> Alameda
Corridor (6,000' Intermodal) - Stryker Brigade (08/23/2006)
  FT_OIMQ2  1      3      BB_BaSu
                          BB_SuSn
                          BB_SnRt                  2                  0
      1            00:00-23:59       2
  FT_OIMQ2  2      3      BL_RtSn
                          BL_SnSu
                          BL_SuBa                  2                  0
      1            00:00-23:59       2
```

Output.dat (North of Colton Crossing)

```
Freight Train   BNSF(Barstow-LA) Barstow -->Summit -->San Bernardino --
>Alameda Corridor ( 6,000 Intermodal (Z TYPE)- Stryker Brigade )
schd[20]    BB_BaSu     FT_OIMQ2    6000  39      2.00                 85.29
1.20    84.46       87.80               244.42  43.73  190.76      395.84
           62.81  43.73    9.14      214.23               0.002    1.00
1.20     0.38

Freight Train   BNSF(LA-Barstow) Alameda Corridor -->San Bernardino -->Summit
-->Barstow ( 6,000 Intermodal (Z TYPE)- Stryker Brigade )
schd[21]    BL_RtSn     FT_OIMQ2    6000  34      2.00                 86.85
0.30    86.76       87.80               238.77  38.77  188.30      335.94
           56.07  38.77    5.59      153.24               0.023    1.00
19.81    0.76
```

2010 – Notional Mechanized Infantry Brigade

Additions to schedule.dat (North of Colton Crossing)

```
BNSF:                    Barstow <---> Summit <---> San Bernarndino(main4) <--
-> Atwood(Carload) B1 cannot use main2 - San Diego Mechanized Division
(8/23/2006)
  FT_WCarL1 1     3     BB_BaSu
                        BB_SuC4
                        BB_C4At                 1                 0
      4           18:00-18:00       1.0

                  18:30-18:30       1.0

                  19:00-19:00       1.0

                  19:30-19:30       1.0
  FT_ECarL1 2     3     BL_AtC4
                        BL_C4Su
                        BL_SuBa                 1                 0
      4           04:30-04:30       1.0

                  05:00-05:00       1.0

                  05:30-05:30       1.0

                  06:00-06:00       1.0
```

Output.dat (North of Colton Crossing)

```
Freight Train   BNSF(Barstow-LA) Barstow -->Summit -->San Bernardino --
>AtWood ( West Carload - San Diego Mechanized Division (8/23/2006) )
schd[36]    BB_BaSu     FT_WCarL1   6500  81      4.00                  85.56
1.33    84.46       87.80               257.79  54.89  192.90      477.80
           76.88  54.89   11.99      296.89               0.006    1.00
2.23     0.53

Freight Train   BNSF(LA-Barstow) AtWood -->San Bernardino -->Summit --
>Barstow ( East Carload - San Diego Mechanized Division (8/23/2006) )
schd[37]    BL_AtC4     FT_ECarL1   6500  80      4.00                  86.83
0.25    86.76       87.80               251.84  45.65  199.59      503.04
           52.63  45.65    0.38      303.83               0.121    4.00
43.85    0.85
```

2025 – Surge Sustainment or Stryker Brigade

Additions to schedule.dat (North of Colton Crossing)

```
BNSF: Barstow <---> Summit <---> San Bernarndino <---> Alameda Corridor
(6,000' Intermodal) - Stryker Brigade (08/23/2006)
  FT_OIMQ2  1     3     BB_BaSu
                        BB_SuSn
                        BB_SnRt                 2                 0
      1           00:00-23:59       2
  FT_OIMQ2  2     3     BL_RtSn
                        BL_SnSu
                        BL_SuBa                 2                 0
      1           00:00-23:59       2
```

Output.dat (North of Colton Crossing)

```
Freight Train   BNSF(Barstow-LA) Barstow -->Summit -->San Bernardino --
>Alameda Corridor ( 6,000 Intermodal Stryker Bridge scenario (Q type) )
schd[20]    BB_BaSu     FT_OIMQ2    6000  39      2.00                 84.69
0.13    84.46       84.76              242.87  50.74  186.84      392.78
           58.16  50.74    2.12      208.07              0.005    1.00
3.45     0.23

Freight Train   BNSF(LA-Barstow) Alameda Corridor -->San Bernardino -->Summit
-->Barstow ( 6,000 Intermodal Stryker Bridge scenario (Q type) )
schd[21]    BL_RtSn     FT_OIMQ2    6000  34      2.00                 86.76
0.00    86.76       86.76              225.55  30.28  186.96      306.68
           42.85  30.28    4.26      123.97              0.019    1.00
16.02    0.62
```

2025 – Notional Mechanized Infantry Brigade

Additions to schedule.dat (North of Colton Crossing)

```
BNSF:                    Barstow <---> Summit <---> San Bernarndino(main4) <--
-> Atwood(Carload) B1 cannot use main2 - San Diego Mechanized Division
(8/23/2006)
  FT_WCarL1 1     3     BB_BaSu
                        BB_SuC4
                        BB_C4At                 1                 0
      4           18:00-18:00       1.0

                  18:30-18:30       1.0

                  19:00-19:00       1.0

                  19:30-19:30       1.0
  FT_ECarL1 2     3     BL_AtC4
                        BL_C4Su
                        BL_SuBa                 1                 0
      4           04:30-04:30       1.0

                  05:00-05:00       1.0

                  05:30-05:30       1.0

                  06:00-06:00       1.0
```

Output.dat (North of Colton Crossing)

```
Freight Train   BNSF(Barstow-LA) Barstow -->Summit -->San Bernardino --
>AtWood ( West Carload - San Diego Mechanized Division (8/23/2006) )
schd[36]    BB_BaSu     FT_WCarL1   6500  82      4.00                 84.65
0.15    84.46       84.76              267.17  81.66  182.37      477.14
           83.57  81.63    9.58      293.52               0.022    2.00
7.75     0.18

Freight Train   BNSF(LA-Barstow) AtWood -->San Bernardino -->Summit --
>Barstow ( East Carload - San Diego Mechanized Division (8/23/2006) )
schd[37]    BL_AtC4     FT_ECarL1   6500  80      4.00                 86.76
      -1.#J   86.76       86.76              263.66  51.01  201.29
471.69                  64.45  51.01    2.08      272.48               0.120
4.00    43.39        0.89
```

2006 – Surge Sustainment or Stryker Brigade

Additions to schedule.dat (west of Colton Crossing)

```
BNSF:       Alameda Corridor (Redondo Tower) <---> Cajon Line
      (6,000' Intermodal) - Stryker Brigade (08/25/2006)
  FT_OIM1   1     BN_CjRt                 2                 0
      1           00:00-23:59       2.0
  FT_OIM1   1     BN_RtCj                 2                 0
      1           00:00-23:59       2.0
```

Output.dat (west of Colton Crossing)

```
Freight Train   BNSF line: Cajon -->Alameda Corridor ( 6,000 Intermodal -
Stryker Brigage (08/25/2006) )
schd[46]    BN_CjRt     FT_OIM1     6000  52      2.00                67.72
0.90    66.57       69.77               135.45  34.27   93.40      229.98
           42.23  34.27    0.18      136.76               0.012    1.00
9.03     0.62

Freight Train   BNSF line: Alameda Corridor -->Cajon ( 6,000 Intermodal -
Stryker Brigage (08/25/2006) )
schd[47]    BN_RtCj     FT_OIM1     6000  43      2.00                67.79
0.64    66.53       69.32               170.00  63.71   98.97      390.48
           78.09  63.71    7.06      298.58               0.000    1.00
0.00     0.02
```

2006 – Notional Mechanized Infantry Brigade

Additions to schedule.dat (West of Colton Crossing)

```
BNSF:                          Atwood <---> Cajon Line
      (Carload)   SD mechanized division - 08/25/2006
  FT_WCarL1 1     BN_CjAt                 1                 0
      4           20:40-20:40       1.0

            21:10-21:10       1.0

            21:40-21:40       1.0

            22:10-22:10       1.0

  FT_ECarL1 1     BN_AtCj                 1                 0
      4           03:30-03:30       1.0

            04:00-04:00       1.0

            04:30-04:30       1.0

            05:00-05:00       1.0
```

Output.dat (West of Colton Crossing)

```
Freight Train   BNSF line: Cajon -->AtWood ( West Carload - SD mechanized
division (08/25/2006) )
schd[56]    BN_CjAt     FT_WCarL1   6500  105     4.00                40.85
0.53    40.46       41.68              107.98  27.27   77.58      222.88
           30.40  27.27    8.41      145.30               0.026    3.00
9.46     0.61

Freight Train   BNSF line: AtWood -->Cajon ( East Carload - SD mechanized
division (08/25/2006) )
schd[57]    BN_AtCj     FT_ECarL1   6500  104     4.00                40.92
0.54    40.46       41.68              114.86  64.89   59.13      408.36
           55.74  64.89    7.50      349.23               0.002    1.00
0.65     0.23
```

2010 – Surge Sustainment or Stryker Brigade

Additions to schedule.dat (West of Colton Crossing)

```
BNSF:       Alameda Corridor (Redondo Tower) <---> Cajon Line
      (6,000' Intermodal) - Stryker Brigade (08/25/2006)
  FT_OIM1   1     BN_CjRt                 2                 0
      1           00:00-23:59       2.0
  FT_OIM1   1     BN_RtCj                 2                 0
      1           00:00-23:59       2.0
```

Output.dat (West of Colton Crossing)

```
Freight Train   BNSF line: Cajon -->Alameda Corridor ( 6,000 Intermodal -
Stryker Brigade (08/25/2006) )
schd[46]    BN_CjRt     FT_OIM1     6000  52      2.00                67.69
0.81    66.91       69.75               114.97  16.24   92.11      172.97
          23.30  16.24    0.44       81.30               0.003    1.00
1.89     0.29

Freight Train   BNSF line: Alameda Corridor -->Cajon ( 6,000 Intermodal -
Stryker Brigade (08/25/2006) )
schd[47]    BN_RtCj     FT_OIM1     6000  43      2.00                67.59
0.84    66.53       69.33               119.29  20.53   92.58      211.29
          26.71  20.53   11.97      118.71               0.000    1.00
0.26     0.09
```

2010 – Notional Mechanized Infantry Brigade

Additions to schedule.dat (West of Colton Crossing)

```
BNSF:                          Atwood <---> Cajon Line
      (Carload)   SD mechanized division - 08/25/2006
  FT_WCarL1 1     BN_CjAt                 1                 0
      4           20:20-20:20       1.0

            20:50-20:50       1.0

            21:20-21:20       1.0

            21:50-21:50       1.0

  FT_ECarL1 1     BN_AtCj                 1                 0
      4           03:30-03:30       1.0

            04:00-04:00       1.0

            04:30-04:30       1.0

            05:00-05:00       1.0
```

Output.dat (West of Colton Crossing)

```
Freight Train   BNSF line: Cajon -->AtWood ( West Carload - SD mechanized
(08/25/2006) )
schd[46]    BN_CjAt     FT_WCarL1   6500  104     4.00                 40.74
0.62    40.46       42.36                96.25  18.37   75.72      179.27
          20.53  18.37    8.64      103.54               0.013    2.00
4.60     0.50

Freight Train   BNSF line: AtWood -->Cajon ( East Carload - SD mechanized
(08/25/2006) )
schd[47]    BN_AtCj     FT_ECarL1   6500  104     4.00                 41.21
0.85    40.46       42.36                79.32  20.24   58.59      176.52
          19.15  20.17    1.56      116.27               0.001    1.00
0.19     0.09
```

2025 – Surge Sustainment or Stryker Brigade

Changes made to schedule.dat (West of Colton Crossing)

```
BNSF:       Alameda Corridor (Redondo Tower) <---> Cajon Line
      (6,000' Intermodal) - Stryker Brigade (08/25/2006)
  FT_OIM1   1     BN_CjRt                 2                 0
      1           00:00-23:59       2.0
  FT_OIM1   1     BN_RtCj                 2                 0
      1           00:00-23:59       2.0
```

Output.dat (West of Colton Crossing)

```
Freight Train   BNSF line: Cajon -->Alameda Corridor ( 6,000 Intermodal -
Stryker Brigade (08/25/2006) )
schd[46]    BN_CjRt     FT_OIM1     6000  52      2.00                67.38
0.83    66.53       69.82               129.85  23.51   95.16      199.05
           38.18  23.51    3.49      107.39               0.001    1.00
0.77     0.17

Freight Train   BNSF line: Alameda Corridor -->Cajon ( 6,000 Intermodal -
Stryker Brigade (08/25/2006) )
schd[47]    BN_RtCj     FT_OIM1     6000  43      2.00                68.52
1.37    66.95       71.31               119.71  16.73   93.17      161.97
           27.13  16.73    0.59       69.39               0.003    1.00
2.75     0.28
```

2025 – Notional Mechanized Infantry Brigade

Changes made to schedule.dat (West of Colton Crossing)

```
BNSF:                          Atwood <---> Cajon Line
      (Carload)   SD mechanized division - 08/25/2006
  FT_WCarL1 1     BN_CjAt                 1                 0
      4           20:30-20:30       1.0

            21:00-21:00       1.0

            21:30-21:30       1.0

            22:00-22:00       1.0

  FT_ECarL1 1     BN_AtCj                 1                 0
      4           03:30-03:30       1.0

            04:00-04:00       1.0

            04:30-04:30       1.0

            05:00-05:00       1.0
```

Output.dat (West of Colton Crossing)

```
Freight Train   BNSF line: Cajon -->AtWood ( West Carload - SD mechanized
(08/25/2006) )
schd[56]    BN_CjAt     FT_WCarL1   6500  104     4.00                41.04
0.77    40.46       42.18               106.56  18.88   75.72      173.45
          30.84  18.88    6.92       97.72               0.002    1.00
0.84     0.22

Freight Train   BNSF line: AtWood -->Cajon ( East Carload - SD mechanized
(08/25/2006) )
schd[57]    BN_AtCj     FT_ECarL1   6500  104     4.00                42.03
1.18    40.46       43.17               76.36  14.03   60.25      145.89
          16.11  14.03   11.34       85.64               0.001    1.00
0.41     0.17
```

ACRONYMS

ACRONYM	DEFINITION
BNSF	Burlington Northern Santa Fe
CTC	Centralized Traffic Control
DoD	Department of Defense
ICTF	Intermodal Container Transfer Facility
ITS	International Transport Solutions, Inc.
JPPSP	Joint Power Projection Support Platform
NMFD	Notional Military Force Deployment
NTC	National Training Center
PHL	Pacific Harbor Line
POLA	Port of Los Angeles
POLB	Port of Long Beach
SCAG	Southern California Association of Government
SCIG	Southern California Intermodal Gateway
SCRRA	Southern California Regional Rail Authority
SOCAL	Southern California
TEU	Twenty Foot Equivalent Container Unit
UP	Union Pacific
UPRR	Union Pacific Railroad